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Editorial Notes

Competition from Coal

In our past two issues we have published an article, under the title "You have been warned", by a fuel technologist of standing. In it the writer discussed the growing competition from coal—a subject on which we have commented at some length in these columns of late. He stated categorically that, though the new "burn more coal" campaign is supported financially by the coal owner, it is the coal merchant who is really the driving force behind it. So long as the coal owner receives a price for his coal that enables him to pay a reasonable dividend and to pay normal wages to his men he is satisfied. The gas undertaking, our contributor pointed out, may buy coal direct from the colliery. The merchant gets no commission and makes no profit. Gas is sold direct to the consumer, and not only does the merchant get no profit from the transaction, but house coal which he would otherwise sell is displaced. The coal owner is, of course, interested in that he is worried about a diminishing of the house coal market due to the inroads of gas and coke. As to the latter, the merchant can work hand-in-hand with the gas undertaking and market coke at a profit.

The author expressed grave fears for the Gas Industry as the outcome of the well-organized research on coal and coal-burning appliances and intensified propaganda and better methods generally in selling raw coal. In particular he emphasized the development of the automatic stoker for central heating and hot water supply. The automatic stoker burns cheap slacks efficiently and without appreciable smoke production. It does represent competition. The Gas Industry is not unused to competition; it will intensify its efforts. We are not so fearful of the automatic stoker as is our contributor. The size of these stokers has been brought down to a rating as low as 20 lb. of coal per hour. At this rating, assuming a usage of 16 hours a day, it consumes a ton of coal a week. This is a class of consumer quite apart from the ordinary householder; and millions of ordinary householders are served by the Gas Industry. And for big and constant loads gas can be supplied at low rates. It must be remembered, too, that the automatic stoker uses electricity; we do not know what the maintenance costs are, but they must be appreciable, and, though the stoker is "automatic," its use entails labour in fuelling and in the removal of ashes.

Then the author spoke of future activities of the coal industry in the direction of breaking up household coal and selling it to the consumer in handy packages, so that it will be clean and convenient to handle. Well, if this comes about it will add to the cost of both production and marketing and it will not get rid of the necessity for storage and for the removal of ashes, nor will it get rid of smoke. The use of coke also needs storage space and the removal of ashes, but compared with coal it is a clean fuel, a more efficient fuel, and it is smokeless. The ordinary run of gas-works coke is not suitable for use in the open coal grate. It is eminently suitable in the grate designed for its use, and it is the most economical fuel. Our contributor stated that the coal interests have become aware that low volatile steam coals can also be burned satisfactorily in the coke grate. These coals are much more expensive than gas-works coke. Regarding this, he said that the price advantage of gas-works coke over these steam coals may not be permanent. That may or may not be, and the taking of the long view is not very helpful unless we have due regard for the present and take full advantage of conditions as they are. And, as we have emphasized so many times, every installation of a coke grate is a step towards the consolidation of the Gas Industry and a step towards cheap gas. "Nothing is permanent except change." This is true. Let the Gas Industry put forward more efforts to replace coal grates by those designed for burning coke.

Coke is a half-way house between raw coal and gas. It is more convenient than coal apart from the fact that it is bulkier, and, as we have said, it is smokeless. More and more are people realizing the evils of smoke. These evils will not be eliminated unless they can be eliminated at no greater expenditure on fuel. But the Gas Industry has demonstrated clearly that a smokeless fuel service can be had at a cost no greater than a smoky fuel service. In and out of season it must acquaint local authorities and the community generally with this established fact. The Industry will be faced with more competition from raw coal. That is no reason for Stygian gloom. The demand for labour-saving will increase, not decrease. More gas will be used

for heating and water heating and there will be more all-gas houses. It is unthinkable that the coal industry will make inroads into the gas cooking load. It is all going to be a bit more difficult, which is not a cause for despair or panic.

We published the articles with the object of showing the trend of present developments in research on raw coal utilization and marketing, and to point to directions in which competition is likely to be intensified. We take no gloomy view of the position, especially if the Gas Industry is alive to it in advance. Obviously we welcome any effort to render smokeless the combustion of such coal as must continue to be burned in the raw state. Efforts, however, to increase in any way the quantity so consumed appear to us so retrograde and contrary to the national interest as to be doomed to failure.

Gas in Industry

We have said that abolition of the smoke evil depends on the availability of smokeless methods which are not more costly than raw coal, and that in gas and coke these alternatives *are* available. This all-important matter of smoke abatement was the subject of a Paper presented on Saturday last by Dr. H. A. Fells, of the Sheffield and District Gas Company, to the Yorkshire Junior Gas Association. It will be found on later pages of our issue to-day. Dr. Fells is especially well fitted to deal with the question, for prior to his appointment with the Sheffield Company he was investigator for the Sheffield and District Steel Manufacturers' Smoke Abatement Research Committee.

The historical review which formed part of his Paper is a most valuable record, and will prove most useful as a reference. As early as 1819, he pointed out, a Select Committee of the House of Commons was appointed to enquire into the smoke nuisance with a view to introducing legal measures for its abatement, and at the time reference was made to "the perfection of gas and its usefulness" as having great possibilities in the prevention of wastage of fuel and abatement of smoke. No legislation resulted from the work of this Committee. A second Committee reported in 1843, and a third in 1845, when a Bill to appoint inspectors of smoke nuisances and to impose fines for smoke offences met with concerted opposition from the heavy industries and was withdrawn. The only apparent results from these early deliberations were a clause in the Towns Improvement Clauses Act of 1847 and a section in the Public Health Act of 1875. Ironworks were exempted from the clause. Then, in 1926, came the Public Health (Smoke Abatement) Act; again the steel industry was for a period of five years granted specific exemption from legal action regarding the production of smoke. What is evident, observed Dr. Fells, is the fact that "every attempt to produce legislation regarding the smoke nuisance has met with very determined and concerted opposition by industrialists, and the Government has been persuaded to sacrifice social ideals to the benefit of vested interests."

In all the evidence submitted to claim exemption for the steel processes, much so-called scientific data had been included and the conviction had been expressed that black smoke was really essential to the proper production of certain steels. In all heating processes of steel and iron it is difficult to avoid scaling, and with coal fired furnaces the normal loss of metal due to scaling is from 3 to 5%. Decarburization is another source of damage. It is the attention given to the prevention of scale and decarburization of steel by controlling the combustion of fuels in furnaces which has led to the scientific precision of atmosphere-controlled furnaces as we know them to-day. Dr. Fells observed that, on an annual production of steel by Great Britain of 10 million tons at an average cost of only £8 per ton, loss due to scale represents anything from £2,400,000 to £4,000,000. In a specific instance in Sheffield, where the firm formerly used coal-fired furnaces for heating high-speed steel for forging, the normal loss of metal as scale was as high as 9%, representing a loss of £18 per ton.

A Changed Outlook

In 1929 a Memorandum was prepared by the Technical Department of the National Federation of Iron and Steel Manufacturers summarizing the work already done to abate smoke in the Sheffield area. Even in this recent Memorandum evidence was given that black smoke was still considered essential. In the following few years much research work was carried out to test the age-long slogan that "black smoke is necessary for the proper heating of steels," and some of the finest research work on the subject was carried out in the Fuel Department of Leeds University by Professor Cobb and his co-workers. Investigations, in which Dr. Fells played a large part, were also undertaken on a full works scale. The results of the work, both in the laboratory and in the steel works, were very definite and were destined to have far-reaching effects. Among the results were that black smoke is *not* essential to prevent surface damage to steels during heating, and that surface damage to steels can be prevented, without the production of black smoke, by using furnaces designed to burn town gas. The acceptance of these findings by the steel manufacturers marked the beginning of a new outlook on the problem of metallurgical smoke; and from this time on the question of the need for black smoke gave place to the fundamental problems of the cost of suitable plant and the cost of suitable fuels to use in it.

Dr. Fells outlined the part played by the Sheffield and District Gas Company in developing the use of town gas as a fuel for the steel industry, and a very good story he had to tell—a story of determination and enterprise. The South Yorkshire Gas Grid—the first in the country—was formed by the Sheffield Company in 1930. The steel manufacturers by that time, thanks to the work of the Company's Industrial Department, had been led to realize the value of town gas, but the vital question was that of cost. After detailed consideration it was decided to offer coke oven gas for contracts of 30 million cu.ft. a year at 2·4d. per therm. This price proved attractive, and in 1931 a load for steel heating was developed of 2,367 million cu.ft.; in 1937, this had risen to 6,981 million cu.ft. There was a substantial increase last year. Gas is now being used principally for those very processes for which previously black smoke was deemed necessary. Before gas heated furnaces were installed thousands of tons of coal were used per week in Sheffield in furnaces operated in a manner designed to produce smoke. Now, millions of cubic feet of gas are used per week instead in furnaces which emit no smoke whatever. Gas is replacing 240,000 tons of coal per annum in the heavy section of the Sheffield steel industry. An interesting calculation put forward by Dr. Fells shows that 3½ million therms of gas does the same work as 12 million therms of coal, which in turn means that the effective price of gas sold at 2·4d. per therm is actually only 0·7d. per therm on a coal cost basis.

First fuel cost, however, is not the only consideration. There are other factors of great economic importance. Dr. Fells observed that a saving of only 1% of metal by reducing scale formation means a money saving of 2s. per ton with steel costing as little as £10 per ton. One firm in Sheffield has, by replacing coal by gas, been able to reduce scale

formation by 3%, and as the metal treated costs £200 per ton the direct saving is £6 per ton of metal. The cost of heating and reheating a ton of steel is only 15s. when using gas. The pioneer work of the Sheffield and District Gas Company has not only meant a substantial diminution of the smoke evil in the area; it has also made the heating of steel a precision task. It has helped the steel trade not only to maintain quality and rate of output, but to improve them. The Company has performed, and continues to perform, a very real national service.

Gas Propulsion

Of late we have heard more about the use of producer gas as a motor fuel than of the use of compressed gas in this country. The development of compressed gas is, of course, going ahead abroad, and in this connexion some very interesting figures were given in the "Journal" for Oct. 12 last in our extract of a report on progress in the use of gas in Central Europe presented at the 61st Congress of the Union Syndicale de l'Industrie Technique du Gaz en France. In Central European countries, as also in France, much encouragement is given. In the latter country each owner of more than ten lorries is obliged to equip at least one of them with a producer, or, as an alternative, with fittings enabling bottled gas to be used. In Germany more than 50 towns have been provided with gas-filling stations.

From the point of view of running costs the gas producer vehicle has much attraction. The Paper at the recent Coal Convention by the Duke of Montrose clearly demonstrated this, and similar evidence was forthcoming in a Paper to the Institute of Fuel shortly afterwards by Messrs. Goldman and Jones. The principal obstacles to the rapid development of producer gas propulsion are the extra weight of the producer and other equipment, and the inclusion of the producer plant in the unladen weight of the vehicle for the purposes of road traffic licence legislation. The decrease in the pay load due to extra weight is also a disadvantage of the compressed gas vehicle. Pointing out that electric vehicles are allowed to exclude the weight of their batteries when ascertaining their unladen weight for licensing purposes, the Duke of Montrose suggested that the producer gas vehicle should be given the same privilege in respect of the weight of the producer plant. Messrs. Goldman and Jones urged the utilization of gas producer vehicles on the grounds of commercial economy in peace and obvious advantages in time of war. The portable producer gas plant, they maintained, provides a reliable and practical means of using a cheap and readily available home produced fuel, and progress would be hastened by co-operation. The Gas Industry is in a position to manufacture reactive cokes suitable for use in the portable producer, and will naturally follow any development of the producer gas propelled vehicle and any change which may be made in the regulations covering its use. Change would, of course, affect the prospects of the compressed gas vehicle. Concessions in regard to the producer gas lorry could hardly be withheld from the compressed gas vehicle.

Then again the Industry will watch new developments in the design of the motor itself. In the "Journal" for July 21, 1937, we published an article on the Erren cycle for internal combustion engines—an injection system which, it is stated, enables coal gas to be used in the internal combustion engine with an actual gain in efficiency and power as compared with petrol. Jointly with the United Kingdom Gas Corporation the National Gas and Oil Engine Company have acquired the rights of the Erren system for this country.

Electrical Sales Methods

The *Caterer and Hotel Keeper* for Jan. 6 gave prominence to the strong opposition which London hoteliers and restaurateurs are putting forward against attempts being made by electricity supply companies to force them to scrap existing gas and coal cooking equipment and use electrical plant instead. The companies are refusing to renew contracts on the two-part tariff unless more electricity is used—and their drive is to ensure this by installing electrical cooking equipment. We are glad to learn that this dictation is being strongly resisted. Some chefs, stated the *Caterer and Hotel Keeper*, which, of course is unbiassed in its attitude towards gas or electricity, find that certain cooking operations are impossible with electricity.

Damage to Water Heaters

The recent severe cold spell resulted in some cases in damage to gas water heaters, and the question has naturally arisen as to who is responsible for paying for their repair when the appliances are installed under hire-purchase agreements with free maintenance. "Free maintenance" covers fair wear and tear, and not damage such as that caused by the accident of frost. The consumer, then, it would appear and not the gas undertaking, is responsible. The matter is an interesting one from the insurance point of view. The terms of the ordinary household comprehensive policy provide for claims in respect of damage to structure, furniture, decorations, &c., as a result of burst pipes, tanks, or other water fittings, but do not cover damage to the pipes and fittings themselves. The question therefore arises as to whether a gas water heater is to be regarded as a normal "water fitting," *not* subject to claims, or as a subsequent "furnishing" subject to claims. We have discussed the point with a representative of a leading insurance company, and it would appear that insurance companies generally are inclined to regard such appliances as water fittings—and therefore not subject to claims. On the other hand, we were informed every individual claim would be considered on its merits, and that reasonable applications would probably be met. The vast majority of insurance companies would, of course, be prepared to arrange special cover for such contingencies, for which the premium would be exceedingly modest.

Sulphate of Ammonia

We publish in this issue an extract from the annual report for 1937-38 of the British Sulphate of Ammonia Federation, Ltd. The past year, it is interesting to note, was the 41st year of propaganda work undertaken successively by the Sulphate of Ammonia Committee, the Association, the Federation, Nitram, Ltd., and Imperial Chemical Industries, Ltd. The increase in fertilizer nitrogen was 5·2%, compared with 12·5%, in the previous year. Each main class of fertilizer showed an increase. Ammonium sulphate increased by 5·1%, but home consumption of sulphate showed an increase of only 0·6%, following an increase of 2·1% in the previous year. Exports of sulphate from Great Britain and Ireland show an increase of 18%. Synthetic nitrogen plants have on an average operated at only 53% of capacity during the year. At the close of the year membership totalled 192.

Newcastle's Domestic Tariff

Further to popularize their "domestic tariff," with which in the winter quarters gas in excess of 60 therms per quarter (40 therms in the summer) in houses with 4 or less assessable rooms is charged at the low rate of 3·06d. per therm net, the Newcastle-upon-Tyne and Gateshead Gas Company have hit upon a happy idea. This is to attach to the account for the quarter a conspicuous slip calling attention to the amount the consumer has saved by being on the "domestic tariff" rather than on the flat rate. Two forms of letter accompany the accounts. One is for those who are on the "domestic tariff" but who could use more gas to displace solid fuel; the other is addressed to those who use gas to the exclusion of solid fuel. The latter asks consumers to tell their friends about their experience and thus help to achieve a smokeless Britain. This is just another example of Newcastle's effective salesmanship.

Personal

Mr. EDWARD WILSHAW, J.P., Deputy-Chairman of the Romford (Essex) Gas Company, has been appointed a Lieutenant of the City of London.

Apart from Mr. Wilshaw's activities in the Gas Industry he is Britain's Communications Chief. He was the author of the scheme for a low flat rate for Empire communications which came into operation early last year, and in December last he made an offer to the British Government for the creation of a wireless chain throughout the Colonial Empire free of cost.

Mr. Wilshaw is the sole Managing Director and Government approved Chairman of Cable and Wireless, Ltd., and Managing Director of all its subsidiary companies. These companies, which control a network of three hundred thousand miles of cable all over the world, have capital totalling almost £100,000,000.

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Mr. J. K. NEWSOM DAVIS, a Managing Director of the Davis Gas Stove Company, Ltd., and son of the late Mr. Harold Newsom Davis, has been appointed a Director of Radiation Ltd.

* * *

Mr. G. F. RICKARD, Secretary of the Newquay and District Water Company, has been appointed Secretary to the Truro Gas Company.

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An inscribed gold watch was presented to Mr. J. W. DUNSDON on his retirement from the position of Chief Mains Inspector to the Nottingham Gas Department. He has served the Department for thirty-eight years.

* * *

At a recent meeting of the Club de la Publicité, in Paris, it was decided to invite certain specialists in publicity and propaganda in other countries to become members. One of the names chosen for election was that of Mr. WILLIAM R. OLIVER, B.C.G.A. Display Officer, in recognition of his Address given before the First International Convention of Window Display at the Third International Advertising Convention in Paris on July 6, 1937.

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Mr. ERNEST E. BIRD has been elected a Director of the Bournemouth Gas and Water Company in the place of Sir John J. Withers, C.B.E., M.P., who, through a desire to reduce his responsibilities, has resigned.

Obituary

We regret to announce the death after a brief illness of Mr. A. REGINALD JUBB, who, for the last thirteen years, has been Engineer and Manager of the Melton Mowbray Gas Light and Coke Company.

Mr. Jubb, who was thirty-seven, was formerly on the staff of the Leicester Gas Department. Since he was appointed Engineer and Manager at Melton, the Company has made considerable progress. Mr. Jubb leaves a widow and one son.

* * *

We regret to announce the death on Jan. 5, 1939, following a series of operations, of Mr. H. STONEWALL JACKSON, for many years Manager, and, latterly, a Director, of Spencer-Bonecourt, Ltd. He retired from active work only three months ago. Originally with Richardsons, Westgarth, & Co., Ltd., of Middlesbrough, he was closely associated with the late Tom Westgarth in the development of that firm's specialities, both for marine and steelwork purposes, including rolling mill engines and the mechanical gear for large tilting furnaces. Mr. Jackson had a service record of some sixteen years with Spencer-Bonecourt, Ltd.

Letters to the Editor

Welsh Steam Coals in the Open Firegrate

SIR,—My attention has been drawn to the reply by Drs. Davidson and Hartley to my criticism of their Institution Paper, which appeared on p. 777 of your issue dated Dec. 7, 1938.

The main point of my criticism was that a comparison of the relative radiation efficiencies of cokes and smokeless coals had been drawn from a series of experiments in which the tests on coke included tests carried out under optimum conditions, while the tests on the smokeless coals were not carried out under optimum conditions. From the vast amount of work that has been done on coke by several research organizations, the optimum conditions are fairly well established for coke, but there was no evidence in the Paper under discussion that any attempt had been made to determine the optimum conditions for the smokeless coals and semi-coke. The maximum weight of the initial charge with coke was 11·7 lb., whereas the weight of a steam coal of 13·9% volatile matter was 17·6 lb. In my view, there was no reason why the weight of coal should have exceeded 11 lb. or so, which is the quantity of steam coal which I have used in my tests. One important point which they have overlooked is the fact that coal of that type, although normally occupying less space than an equal weight of coke, actually "grows" under heat treatment in the grate and occupies an appreciably increased volume.

The slides which I exhibited at the Institution meeting showed the remarkable increase in radiation per lb. of fuel when using charges of 11 lb. as against 9 lb., so that I again insist that it was unfair to compare test No. 16 with Nos. 1, 2, or 3, where the initial charge of semi-coke was 8·4 lb., and the charges of coke 10·3 to 11·7 lb.

Further, on a previous occasion Dr. Davidson made several tests with semi-coke, and he then found that he got the highest radiant efficiency when the size of fuel used was 1 to 4 in., but in test No. 16 the size of fuel taken was ½ to 3 in.

I am satisfied also from my experience that better results would have been obtained with these Welsh steam coals if cobbles had been used instead of nuts. Cobbles were not tested in the experiments described by Dr. Margaret Fishenden.

The Authors say that "In the light of our experience we should reject, as liable to be inaccurate, claims as to radiant efficiencies based on observations taken at a single position in front of the fire." I am unable to reconcile this professed desire for accuracy with the fact that in their tests they made an error of close on 70% in the weight of the charge of steam coal used in the experiment. In circumstances such as these I fail to see the point of using an instrument which gives results to the second decimal place, where visual inspection should have been sufficient to demonstrate that optimum conditions were not being adopted.

The use of an instrument in a single position in front of the fire, or one which records a constant temperature at varying distances from the fire, "does not lessen the value of these tests, since they are strictly comparative, being carried out in exactly the same manner." This last quotation is taken from Dr. Davidson's Paper read before the Scottish Junior Gas Association (Western District) at Glasgow in 1937 ("JOURNAL" for April 28, 1937). The results obtained by Drs. Davidson and Hartley are not comparative, for the reasons which I have given. I cannot, therefore, accept their conclusions that "the highest radiant efficiency was attained with gas-works coke."

Finally, on the question of "useful fire," I confess that I do not understand why one fuel which gives a radiation of 8,000 B.Th.U. per hour should be regarded as "useful," while another giving out radiant heat at the same rate would not be regarded as "useful."

Yours, &c.,
JOHN ROBERTS.

5, Victoria Street,
Westminster, S.W. 1,
Jan. 11, 1939.

Newcastle Coal Prices Enquiry

SIR,—On p. 121 of your issue of Jan. 11 there appears an abbreviated account of the proceedings before the Durham District Committee of Investigation on Jan. 6.

Towards the end of that account, Counsel for the Complainant Gas Company is reported to have stated that the 6,500,000 tons of Durham gas coal supplied coastwise to gas undertakings was sold at 17s. 3d. per ton. This statement is quite incorrect and was not in fact made.

It is not the intention of the Durham Sales Control Committee to publish the actual price, but you may take it that the correct figure paid was considerably more than the 17s. 3d. indicated in your report.

Yours, &c.,
for the Durham Sales Control Committee,
H. V. W. FRASER.

21, Collingwood Street,
Newcastle-upon-Tyne 1,
Jan. 16, 1939.

News of the Week

The Growing Popularity of Gas is referred to in an informative article contributed by Mr. H. D. Madden, M.Inst.C.E., Engineer and Manager of the Cardiff Gas Light and Coke Company, to the *Western Mail* Trade Supplement of Jan. 9.

A Lecture was given by Mr. Arthur Forshaw, M.Sc., Chief Chemist of Messrs. R. & A. Main, Ltd., on "Temperature, Health, and Comfort in Gas-Heated Rooms" to the members of the Sales and Service Department of the Croydon Gas Company on Jan. 10.

The New Brighouse Showrooms, which were described and illustrated in our issue of Jan. 4, are effectively illuminated on the exterior. This is carried out by a series of "Avil" patent strip lanterns by Foster & Pullen, Ltd., these being mounted on special brackets and having 10-light burners with "Staybrite" steel reflectors.

An Increase in the maximum price from 5s. 6d. to 7s. per 1,000 cu.ft. is proposed by the Bala Urban District Council. The Council are to apply for an Order giving them power to increase the price, and also to extend the limits of supply, if necessary. Alterations and additions to the Council's Gas-Works are also to be put in hand in the near future.

Two Steam Engines, which for years have hauled coal to Peterborough Gas-Works from the railway station, are to be replaced by petrol tractors by the end of March. The traction engines and trailers have rubber-tired wheels, but the authorities have decided that they are not suitable for present-day requirements. Several generations of Peterborough boys will miss their old friends!

A Czechoslovakian Firm has Approached the Doncaster Corporation Gas Committee, making enquiries regarding the possibility of establishing works at Doncaster. It is possible that the firm, if established, would consume more than 50% of the present output of the Gas-Works. The firm manufactures glass articles of every description. Plans for the extension of the Gas-Works are already under consideration.

Application is to be made by the Bury Town Council to borrow £7,358 for the erection of new showrooms and offices for their Gas Department.

A Domestic Two-Part Tariff, which is entirely optional, has been introduced by the Watford and St. Albans Gas Company. In Watford, for example, instead of buying gas at 9·6d. per therm, the consumer can pay a fixed quarterly charge based on the size and net rateable value of his house and then buy all his gas at almost half-price—*i.e.*, 5½d. per therm.

A Striking Oasis of Light was provided by the Lytham St. Annes Gas Department's showroom in the town's shopping thoroughfares last week when the Borough experienced an eight-hour electricity "black-out." Townspeople who congregated on the brilliantly illuminated stretch of road in front of the showroom were agog with excitement when the strains of wireless music reached them from inside the showroom, and many of them learned for the first time that it was possible to have gas-operated radio!

The Annual Dinner of the East Midlands Branch of the Institution of Heating and Ventilating Engineers was held at the Victoria Station Hotel, Nottingham, on Jan. 13, Mr. J. Hughes presiding over a company of about eighty. Among those who attended were Mr. T. H. B. Whiting, Professor C. H. Bulleid, who is Chairman of the East Midlands Branch of the Institution of Mechanical Engineers, Mr. W. Charles, Mr. W. Mumford Bailey, Mr. F. Simpson, and Mr. G. Dixon, Chairman of the East Midland Section of the Institute of Fuel.

Amalgamation and Grouping

United Kingdom and Princes Risboro'.

Close Brothers, Secretaries, announce that the United Kingdom Gas Corporation, Ltd., has acquired over 84% of the Ordinary Shares of the Princes Risboro' Gas Light and Coke Company, Ltd., the purchase consideration for which was satisfied entirely by the allotment of Ordinary Shares of the Corporation.

A Model All-Gas House

This scale model all-gas house, measuring 9 ft. wide by 9 ft. high, proved a great attraction at Christmas time in the principal showroom of the Sunderland Gas Company.

DESIGNED and constructed entirely by the staff of the Sunderland Company, the rooms each measured 3 ft. 2 in. from floor to ceiling, being built separately of three-ply wood. The decoration and furnishing of the various rooms were as follows:

Dining-Room.—Warm colours with mahogany furniture and gas fire finished in gold.
Bedroom.—Green and cream with oak furniture and silver-finished gas fire.
Kitchen.—Blue and white with silver oilcloth curtains.
Bathroom.—Green marble effect with rich cream-tiled floor.

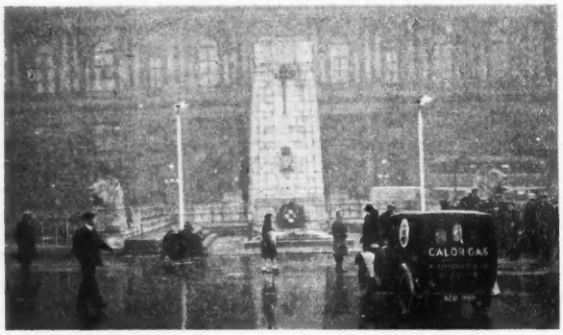
The gas appliances, comprising cooker, water heater, refrigerator, fires, and portable heater, were made of wood, and lights placed behind the fires shining through red gelatine lent a realistic appearance. A card bearing the words "This is cosy—I'm not moving from here to-night" was suspended above the figure of Father Christmas sitting before the bedroom fire. It will also be noticed that gas lighting was represented throughout the house.

The vast majority of people, no matter what their age, love models of any kind, and apart from its particular suitability as a Christmas display, we suggest that such a model, with seasonal variations, will always arouse intense public interest and attract attention to the appliances exhibited.

Hogmanay in Glasgow

Calor Gas Does a Good Job

The new Lord Provost of Glasgow decided that he would like the citizens on Hogmanay to meet in George Square in front of the Municipal Buildings. After consultation as to how the event could best be made attractive, the Gas Undertaking were entrusted with providing suitable illuminations. Only a few days were available, and difficulty arose through there being no mains near the Square. Accordingly the Manager approached the Calor Gas (Distributing) Company, Ltd., and it was decided that an effort be made to produce flambeaux torches such as were used in London during the Coronation Celebrations. A wire to the Gas Light and Coke Company produced four of these by passenger train on Friday, Dec. 30, and the Calor Company produced the excellent effect shown in our photograph.



The result was very pleasing to the Corporation officials, and, in fact, they were so satisfied that they say that next year many more of these torches will be used around the Square and on the roofs of the Municipal Buildings.

Technical Details.

Temperature, 30° F.

The reflections seen in the photograph are not in water but solid ice.

The containers were lifted off the ground and set on wooden stands.

Wind, slight.

Consumption of each flambeau, 35 cu.ft. per hour.

On two of the flambeaux there were 3 containers and 3 regulators each, and on the other two 4 containers and 4 regulators each.

The result was eminently satisfactory, but, of course, there was some anxiety about freezing up. As, however, the flambeaux were only required to be alight for some 3 hours, this trouble was avoided.

It is appreciated that better results would have been achieved with one large regulator and a three-way breech pipe, but there was no time to make the necessary breech pipe nor obtain the large capacity regulator.

A.R.P. Notes

I.C.E. Memorandum on Blast

An introductory memorandum on the subject of blast has been issued by the Engineering Precautions (Air Raid) Committee which was appointed in May, 1938, by the Council of the Institution of Civil Engineers to investigate the problem of air attack as affecting the work of all branches of the engineering profession and to prepare an authoritative report for the use of engineers in the course of their work of designing, constructing, and maintaining structures and other engineering works of public utility.

The Committee, on approaching their task, were of the opinion that since the risk of air attack should be regarded as a permanent liability the whole character of air bombardment and the corresponding protective measures should be made the subject of a carefully conducted scientific enquiry before a considered report could be prepared. As it was foreseen that the necessary scientific work would take some time to complete the Committee prepared to issue from time to time papers or reports, for the guidance of engineers, embodying their conclusions and recommendations, based on the best scientific information available.

The problem of protection against air attack is being considered in three stages:

(1) Protection of structures against the distant effects of heavy bombs and against the combined effects of lighter bombs.
(2) Protection of public services other than structures.
(3) Protection against heavy bombardment.

Memorandum No. 1 is concerned with the distant effect of heavy bombs, and the first part contains descriptions of the observed effects of blast in several cases of explosions of considerable severity. The second part is concerned with the quantitative estimation of blast effects and contains pressure-time curves of the blast waves caused by two separate explosions, in the one case of approximately 1 ton of explosive, and in the other of about a tenth of a pound. Although further records are required before definite conclusions can be reached, the results of these two explosions establish the limits within which the blast effect of an actual bomb explosion might lie.

Blast is a wave of shock that is transmitted through the air to considerable distances from an exploding bomb, and is to be distinguished from the direct effect of the expanding gases which involve pressures of much higher intensity, but effective only at short distances from the bomb.

The direct effect of the expanding gases is probably limited to a distance of 25 ft. for a quantity of explosive which may be taken as representing a 500 lb. bomb and to a distance of about 65 ft. for a hypothetical 3,000 lb. bomb containing 1 ton of explosive.

In the blast wave a phase of positive pressure is followed by a phase of negative pressure, and the combined duration of the phases may range from about a hundredth of a second to about a fifth of a second according to the weight of the bomb. The effect of this wave is to produce a sudden push on a target followed at a short interval of time by a sudden pull, and if the duration of the push is sufficiently long a vibration may be set up in the target such that when the following pull arrives the target is already moving in sympathy with it and the effect is thereby enhanced. The natural frequency of the target is therefore an important consideration, and for targets of comparable static strength those of higher frequency will in general be more easily ruptured than those of lower frequency.

Windows, with their high natural frequencies, may be subject to an equivalent static pressure of the same order as the momentary maximum intensity of blast, but walls and buildings will only be subject to similar equivalent pressures if exposed to very heavy bombs. The maximum pressure produced at a distance of 500 yd. from 1 ton of high explosive is of the order of 0·5 lb. per sq.in., and the pressure is approximately proportional to the reciprocal of the distance.

Investigations are now in progress to determine the equivalent static pressure of the blast for different classes of targets and on the design of protective devices applicable to windows and glazing. Investigation is also being made of the magnitude of the pressure developed inside a shelter due to an external explosion.

The Memorandum is being published in the January, 1939, issue of the Institution Journal, and pamphlet copies of the Memorandum can be obtained on application to the Secretary, the Institution of Civil Engineers, Great George Street, Westminster, S.W. 1.

Radiation Chef in West Indies

This December window arranged by the Barbados Gas Company is of interest. Mr. J. W. Brown, Engineer and Manager, says that he has to thank the Davis Gas Stove Company, Ltd. (Radiation Ltd.), for the head of our old friend the Chef. The "body" and clothing were made at the Company's works. He was introduced to the Barbadian public as "Father Christmas' Cook."

Private Bills to be Introduced in 1939

A *Precis* of the Clauses of those Bills Affecting Gas Interests.

Bognor Gas and Electricity.

This Bill provides for the acquisition of the City of Chichester Gas Company by the Bognor Gas and Electricity Company. It is proposed to change the name of the Bognor Gas and Electricity Company to "The West Sussex Gas and Electricity Company."

Conway Gas.

The preamble to this Bill recites the purchase by the Conway Gas Company of the Gas Undertaking of the Conway Corporation. In this purchase that part of the Borough of Conway which was transferred to the Urban District of Llandudno by the Caernarvonshire Review Order, 1934, was excluded. In this excluded part the Gas Department of the Urban District Council of Llandudno had laid mains and has obtained an Order from the Board of Trade under Section 7 of the Gas Undertakings Act, 1929, transferring this area to their Undertaking. It is alleged that this Order is *ultra vires* on the ground that at the time that it was applied for the Conway Company had laid mains and were supplying gas within that area.

Coventry Corporation.

This proposes to extend the limits for the supply of gas by the Corporation so as to include the part of the Urban District of Kenilworth which formerly formed part of the parish of Leek Wotton.

Dover Coal Dues (Abolition).

This Bill is promoted by the Dover Gas Company and others and proposes to abolish certain dues leviable under Acts of 1778 and 1810 on coal imported into the Town and Port of Dover.

Jarrow Corporation.

This proposes to empower the Corporation to lay out and develop land for "industrial development purposes." The Bill proposes to authorize the Corporation to enter into agreements with companies and other bodies with respect to "industrial facilities" in connexion with any industry. The expression "industrial facilities" is defined as meaning (*inter alia*) arrangements for the supply of gas by authorized undertakers. The Bill, however, provides that nothing therein shall confer upon the Jarrow Corporation any right or power themselves to manufacture or supply gas.

London Building Acts (Amendment).

This Bill proposes to confer various powers upon the London County Council and in particular enlarged powers with regard to the making of by-laws. The Bill would confer upon the County Council power to make by-laws with respect to the installation of gas meters in buildings erected, altered, or converted after the date upon which the by-laws come into operation. Such by-laws may provide for the regulation or control of the position of gas meters, the protection of meters from fire, and the ventilation of enclosed spaces containing meters.

London Gas Undertakings (Regulations).

This Bill is promoted by the London Gas Companies. The Bill requires the Companies within 12 months to make and submit to the Board of Trade for approval, regulations in regard to the following matters: (1) The type, materials, and construction of certain pipes and tubes and the pipe connexions and unions thereof and the testing thereof; (2) the dimensions of such pipes and tubes; (3) the type, materials, construction, position, and method of fitting meters; (4) the provision of cock, valves, and taps and the type, material, and construction thereof; (5) the installation and ventilation of gas-fired appliances, the ventilation of rooms and other parts of buildings in which such appliances are installed, and the fire precautions consequent on or incidental to such installation.

These regulations are to be submitted to a Committee which is to consist of such persons as the Board of Trade may think fit, but the following bodies may nominate members as follows:

The London County Council	2
The Department of Scientific and Industrial Research	1
The Royal College of Physicians	1
The Medical Research Council	1
The Royal Institute of British Architects	1
The Institution of Gas Engineers	1
The Society of British Gas Industries	1
The Companies Jointly	2

The Bill proposes to provide that on the coming into operation of the regulations the provisions of any enactment or by-law for the time being in force relating to the subject matter of any of the regulations shall cease to have effect.

London Rating (Site Values).

This Bill is promoted by the London County Council and proposes to provide for the levying of a rate of 2s. in the £ on the annual site value of all land in the administrative County of London.

Macclesfield Corporation.

Among other provisions, the Bill proposes to confer additional powers on the Gas Department.

Metropolitan Water Board.

This Bill proposes to make it an offence (*inter alia*) to suffer oil or tar to escape into the subsoil in the vicinity of any well or adit belonging to the Metropolitan Water Board.

Tiverton Corporation.

This contains special provisions as to the revenue of the Gas Undertaking of the Corporation.

Walsall Corporation.

This Bill contains usual provisions conferring additional powers upon the Gas Department of the Corporation. The Bill would enable the Corporation to refuse to supply gas to persons whose payments for the supply of gas are in arrear whether the payments are due in respect of the premises for which a supply is demanded or in respect of other premises.

Forthcoming Engagements

January.

19.—S.B.G.I.—Council Meeting, 2.30 p.m.
20.—S.A.G.E.M. (Western District).—Commercial Meeting, Rougemont Hotel, Exeter, 2.30 p.m.
21.—Wales and Monmouthshire Juniors.—Meeting at Newport.
21.—Western Juniors.—Visit to Cheltenham. Paper by Leopold Friedman, of Ascot Gas Water Heaters, Ltd.
24.—I.G.E.—Refractory Materials Joint Committee, 2.30 p.m.
25.—I.G.E.—Pipes Committee at Birmingham, 2.30 p.m.
25.—Southern Association (Eastern District).—Meeting at Gas Industry House, 2.30 p.m. Discussion on "The Operation of a Reconstructed Works."
28.—Scottish Western Juniors.—Visit to Parkinson & Cowan, Ltd., Glasgow.
31.—I.G.E.—Joint Committee on Complete Gasification under Pressure, Department of Scientific an Industrial Research Offices, 16, Old Queen Street, S.W. 1, 3 p.m.

February.

1.—London and Southern Juniors.—Visit to Cricklewood Works of British Oxygen Company.
1.—Manchester and District Juniors.—Visit to Staveley Coal and Iron Company, Ltd., Chesterfield.
2.—Midland Juniors.—Paper by F. A. Reynolds, "Some of the Uses for Gas at Wolverhampton."
4.—Scottish Eastern Juniors.—Visit to Messrs. William Dixon's Coke Oven Plant, Govan Ironworks.
6.—L.C.C.A.—Technical Committee, 2.30 p.m.
7.—I.G.E.—Research Executive Committee, 2.30 p.m.
11.—Scottish Western Juniors.—Paper by D. Beavis, of Helensburgh, on "The Modern Domestic Field."
14.—I.G.E.—Finance Committee, 10 a.m.; Membership Committee, 11 a.m.
14.—London and Southern Juniors.—Paper by A. Ronca on the 1937 Factory Act (at the H.O. Industrial Museum).
14.—N.G.C.—Central Executive Board, 2.30 p.m.
18.—Scottish Western Juniors.—Annual Whist Drive and Dance.

Metallurgical Smoke Abatement - - -

by

H. A. FELLS, B.Sc., Ph.D. (Lond.), A.I.C., A.M.I.Min.E.,

of the Sheffield and District Gas Company.

A Paper read before the Yorkshire Junior Gas Association on Jan. 14, 1939.

Introduction.

The question of Smoke Abatement would appear to be one about which so much has already been said and written that any further contribution would seem superfluous to a body of men well versed in the manufacture and sale of the country's most valuable and widely used smokeless fuels—gas and coke. Having been associated very directly with the problem, first as investigator for the Sheffield and District Steel Manufacturers' Smoke Abatement Research Committee, and later with the Sheffield and District Gas Company, I may be able to put before you certain matters of interest with special reference to smoke produced in the steel industry.

For the purpose of this Paper it is proposed to deal largely with the problems of furnace smoke as produced in the metal industries, and some reference will need to be made to the problem of boiler smoke.

Historical Review of Smoke Abatement.

It is surprising to find that very few people have any conception of the magnitude of the work which has already been done on the problem of smoke nuisance, or of the intricate legal and practical aspects of the problems which have exercised the minds of members of the Government, industrialists, and scientists for ages.

Since the time of Edward I., the King and Legislature have made many efforts, by proclamation and Statutes respectively, to control the smoke nuisance.

As far back as 1648, the citizens of London petitioned Parliament against the importation of coal from Newcastle, and for a time the burning of coal was forbidden in London while Parliament was sitting. It was not until the beginning of the 19th Century that serious attention was given to abating smoke, and as early as 1819, when the manufacture of coal gas was in its very early infancy, a Select Committee of the House of Commons was appointed to enquire into the smoke nuisance with a view to introducing legal measures for its abatement.

In a letter to this Committee of 1819, a certain Mr. Coombe actually made reference to "the perfection of gas and its usefulness" as having great possibilities in the prevention of waste of fuel and of abating smoke. Much of the evidence put before this Committee concerned the elimination of smoke from steam raising plant, and various patented processes were submitted for the combustion of smoke.

No legislation resulted from the work of this Committee, and a second Committee reported to the House in 1843. This Committee covered much ground, embracing nearly every point involved in dealing with combustion and the action of smoke, and it received evidence from such eminent scientists, manufacturers, and persons who had devoted much time to studying the question, as Sir Michael Faraday, Dr. Muntz, and the Rev. Dr. Molesworth, the founder of the Smoke Abatement Association of Manchester.

The following quotations from the report of this Committee of 1843 will show how well the problem of the smoke nuisance was understood and appreciated nearly a century ago.

> "It appears from the whole of the evidence of scientific and practical men, including master manufacturers, that smoke, which is the result of imperfect combustion, may in all cases be diminished, if not entirely prevented. It appears to be the unanimous opinion of the witnesses conversant with the subject that imperfect combustion arises from a deficiency of atmospheric air to mix with and act on the inflammable matter at a proper temperature and under circumstances which must ensure its effective operation; but this admission of air, properly regulated, is the great if not the only principle of preventing smoke which is generally applicable, and that all inventions for the prevention of smoke (except where the smoke has been separated mechanically by an artificial shower of water, produced in a flue constructed for that purpose) are only various applications in different form of this general principle."

Legislation Recommended.

This Committee again emphasized the need for the immediate introduction of legislation to prohibit the production of smoke from furnaces and steam engines—*i.e.*, boilers.

Two years later, in 1845, yet a third Select Committee was appointed because of the opposition given to a Bill prepared by a Mr. Hall, in which it was proposed to appoint Inspectors of Smoke Nuisances, and also to impose fines for smoke offences. It also proposed that if the stoker himself were proved to be at fault, the fine should be deducted from his wages.

The Select Committee reported again that "opaque smoke issuing from steam engine chimneys may be abated as no longer to be a public nuisance." In a later report by the same Committee of 1845, it was stated: "It appears inexpedient under existing circumstances to apply the provisions of the proposed Bill to furnaces connected with the manufacture of iron, copper, and coal works, and with distilleries." I might add that most of the evidence before this Committee came from Leeds, and the exceptions mentioned above were probably made on account of the opposition which the Bill elicited from manufacturers in the specified trades.

The proposed Bill, needless to say, was withdrawn. The Government, however, were fully aware of public opinion on the subject and so appointed Sir Thomas de la Beche and Dr. Lyon Playfair to make a full and scientific investigation into the means adopted to prevent smoke in various parts of the country, and this report, issued in 1846, is extremely valuable and demonstrates how all the difficulties of the subject were recognized at that time. It shows incidentally what little progress has been made during the last 92 years in dealing in a practical manner with the problem.

The appreciation expressed in the report of the meaning of correct combustion of coal, and of obtaining it in practice, and of the fallacies underlying many of the statements frequently put forward regarding the economy of smoke prevention, compares most favourably with present day knowledge of the subject.

A further report was made to the Government in 1855 by the General Board of Health at the request of Lord Palmerston, and some of the statements in it have a familiar modern sound. For example: "The employers of furnaces labour under great difficulty as to the best and most economical use of fuel, because makers of furnaces seem to be guided in their construction by little better than empirical rules, instead of acting upon well established scientific principles or the results of accurate experiments." That statement referred, of course, to coal fired furnaces, as the age of gas fired furnaces had yet to come. A further statement said: "Such is the indisposition of practical men to depart from the beaten track, that nothing but the force of law is likely to ensure the care and attention necessary to protect the public from a grievous nuisance, the manufacturers themselves from heavy unnecessary expense, and the national resources from grievous waste of fuel."

In 1866, the Secretary of State addressed a letter to the Mayors or Local Authorities of a number of large towns in England, asking details respecting the diminution of smoke, what convictions had been obtained, and under what Act of Parliament prosecutions were taken.

Actually in Sheffield alone during the years 1855-1865, 455 successful prosecutions were made, under a single clause in the Towns Improvement Clauses Act of 1847. This shows

that there was a remarkable activity in dealing with the smoke nuisance even in those years.

Lack of Progress.

I have given only a very brief outline of the earlier history of investigations and reports on the already acknowledged nuisance of smoke, but this is sufficient to indicate that, in spite of public opinion, extensive enquiry, and proposed legislation, we have made astonishingly little progress in combating the smoke evil.

The only apparent results of those early deliberations were the single clause in the Town Improvements Clauses Act of 1847, and a section in the Public Health Act of 1875. It is in this latter Act, in Section 334, that we find the first special reference to our subject—Metallurgical Smoke. The Section states:

> "Nothing in this Act shall be construed to extend to mines of different description so as to interfere with or obstruct the efficient working of the same, nor to the smelting of ores and minerals, nor to the calcining, puddling, and rolling of iron and other metals, nor to the conversion of pig iron into wrought iron, so as to obstruct or interfere with any of the processes respectively."

No further legislation was introduced until 1926, when the Public Health (Smoke Abatement) Act was passed, and this Act contained sections adding specifically to the exemptions claims of the 1875 Act, by stating: "Section 334 of the Public Health Act of 1875 shall have effect as if there were included amongst the processes specified in that Section the processes of re-heating, annealing, hardening, forging, converting, and carburizing iron and other metals."

You will see, therefore, from these two Acts that the steel industry, particularly in Sheffield, was granted very specific exemption from legal action regarding production of smoke.

It might be mentioned at this stage that a great deal of work had been required on the part of interested bodies to get this special clause inserted in the 1926 Act. In 1914 a Departmental Committee on Smoke and Noxious Vapours Abatement had been formed, but owing to the outbreak of war had to be abandoned until 1921. From then on, visits were made to steel works, principally in Sheffield, to collect information of the necessary character, and the Committee reported in 1921 that sufficient evidence had been submitted to suggest that for the production of certain grades of steel a smoky atmosphere in the furnace was actually essential.

In 1922, the First Public Health (Smoke Abatement and Noxious Vapours) Bill was introduced, and it was opposed by no less than 75 steel firms in Sheffield. The Bill failed to find a place in the Session's legislation. Three further attempts to introduce a Bill were made in 1922 and 1924, and it was not until a fifth attempt in 1925 that the effort was successful.

The many legal arguments on the various interpretations of different sections of the Acts are not our immediate concern, nor are the many issues on methods of forming and carrying out by-laws by Local Authorities, but sufficient has been submitted to show that the problem of smoke abatement is not a new issue designed as a social or political stunt. What is very evident is the fact that every attempt to produce legislation regarding the smoke nuisance has met with very determined and concerted opposition by industrialists, and the Government has been persuaded to sacrifice social ideals to the benefit of vested interests.

The Steel Manufacturers' Attitude.

It became obvious in recent years that forceful and legal methods were not likely to succeed. Particularly in Sheffield was this appreciated, where in fact the main opposition to proposed Bills had previously arisen. Previous to 1927 the Sheffield Steel Manufacturers, through their Joint Committee, had been compelled to take defensive measures to protect themselves from proposed Bills and alterations to the existing Acts.

Since 1927, they have accepted an entirely different policy, principally because in gaining protection in the 1926 Act they had been given a limited period of only five years before the exemptions were to be reconsidered. They formed themselves into a Research Committee, and commenced a programme of research in an effort to improve existing smoke pall conditions. They were anxious to co-operate with the Local Authority or any Regional Committee dealing with the smoke problem.

This change of attitude was probably influenced by the detailed debate which took place in the House of Commons on the 1926 Act, between such well-known men as Sir Kingsley Wood, Mr. Neville Chamberlain, Mr. Arthur Greenwood, and others. In part of Mr. Chamberlain's statement he said:

> "It may be true that there are means by which it is possible to make steel without making smoke. It may be that that has been successfully accomplished in the great works of Pittsburg, but we have to face the present position in Sheffield where no such means have been adopted and where they cannot be adopted without a very considerable re-organization of the present processes and the expenditure of very large amounts of capital."

Technical and Metallurgical Considerations.

We can now leave the excerpts from the history and the legal side of smoke abatement and consider the practical and scientific aspects of the subject, particularly with regard to the use of fuels in the steel industry. It will be well to remember that in all the evidence submitted to claim exemption for the steel processes, much so-called scientific data had been included, and the evidence had been such that the Government had even been coerced into believing that "black smoke was really essential to the proper production of certain steels."

Steels are liable to slow oxidation at ordinary temperatures and undergo a process of rusting. As the temperature rises this liability to oxidation is increased and the process changes from rusting to scaling. In all heating processes of steel and iron it is extremely difficult to avoid this scaling, and with coal-fired furnaces, operated by even the most skilled furnacemen, the normal loss of metal due to scaling is from 3% to 5%. The amount of scaling is affected by many factors, such as temperature, period of heating, type of steel, ratio of exposed surface of metal to the mass of the metal, and by the condition and quality of combustion of the fuel used.

Another form of damage also occurs involving the removal of carbon from the layer of metal immediately under the scale, and is known as decarburization. These two types of surface damage usually occur together and their combined effects are the cause of multitudinous difficulties in subsequent fabrication of the steel into articles of commerce and engineering, if proper attention is not given to their removal.

Even in the early stages of rolling billets into bars, rods, or wire, scale may be rolled into the metal, and before these rods, bars, and wire can be further used, they require to be annealed. In the annealing it is essential that no further surface damage occurs, since the internal structure has to be uniform throughout the cross-section. Bars and wire are used to make cutting tools, and any faulty surface material has to be removed by machining or grinding so that in subsequent hardening the tools present a correct hardness state at the surface as well as in the centre. In the manufacture of springs, both coiled and laminated, the layer of decarburized metal at the surface is stated to be the cause of the comparatively low fatigue value obtained. In the manufacture of steel sheets, and especially in the final normalizing heat treatment, it is essential to make every effort to prevent surface damage so that a fine, clear, uniform "finish" is obtained. It is in this process, when coal-fired furnaces are used, that copious black smoke is made in the heating chamber, and sheet-heating furnaces have always been the most serious offenders with regard to smoke pollution.

In high speed steel sheet heating the same demand for clean sheet is made, but in obtaining this result there is a decided tendency to produce excessive decarburization. The results of this surface damage appear in the manufacture of hack-saw blades from the sheets, and determine very largely the actual quality of the finished saws.

Financial Aspect of Surface Damage.

I have only given a few of the many effects of scale and decarburization, but in point of fact, it can be said that there is not a single process of steel fabrication which is not in-

fluenced to a major or minor extent by the production of surface damage in the heating stages. It is the attention given to the prevention of scale and decarburization of steel by controlling the combustion of fuels in furnaces which has led to the scientific precision of atmosphere-controlled furnaces as we know them to-day.

In the final stages of heat treatment of steels in the form of precision tools or machine parts, it is possible in fact to improve the actual quality of the steel for the purpose for which it has to be used by as much as 200%, simply by prevention of scale or decarburization. But that is a subject on its own, and involves much metallurgical detail.

Now it is the forementioned types of damage to the surface of steels which have been the real cause of the care and attention given to heating of steels. Years of experience in steel heating in coal-fired furnaces showed very definitely that surface damage could be very materially reduced if black smoke were present in the furnace. Practical furnace men naturally came to a very firm opinion on this subject and insisted on the necessity for black smoke, and even to-day there are still furnace men, and even some fuel technologists, who find it necessary, or shall I say politic, to insist on black smoke.

Apart from the metallurgical and practical aspects of the formation of damaged steel surfaces, there is the all-important matter of financial loss.

Scale represents direct loss of metal, and can be readily given a money value. In general terms the normal loss of metal due to scale formation is from 3 to 5%, and on an annual production of steel for Great Britain of 10 million tons, at an average cost of only £8 per ton, this represents a loss of metal of 300,000 to 500,000 tons, costing £2,400,000 to £4,000,000. In a specific instance in Sheffield, where the firm used to use coal-fired furnaces for heating high-speed steel for forging, the normal loss of metal as scale was as high as 9%, representing a loss of £18 per ton, as this steel is naturally an expensive one.

Practical Methods of Reducing Smoke from Steel Furnaces.

It was not until the passing of the 1926 Public Health (Smoke Abatement) Act that any serious effort was made to consider practical means of metallurgical smoke abatement, and then a concerted effort was begun in Sheffield between the steel manufacturers and the Civic Authority. This resulted in the formation of a Composite Committee of members of the Sheffield Steel Manufacturers' Smoke Abatement Research Committee on Smoke Abatement. I might mention in passing that Sheffield and Rotherham have the only Statutory Committee dealing with smoke in the country

This Composite Committee first sat under the Chairmanship of Dr. Desch, Professor of Metallurgy at Sheffield University, and later under Dr. R. V. Wheeler, Professor of Fuel at Sheffield.

As the five years' exemption given to the steel industry by the 1926 Act was drawing to a close, a Memorandum was prepared in 1929 by the Technical Department of the National Federation of Iron and Steel Manufacturers, summarizing the work already done to abate smoke in the Sheffield area.

This Memorandum, as recent as 1929 remember, gave evidence that black smoke was still considered essential, but also showed what attempts were being made by individual manufacturers to produce suitable furnace atmospheres by various methods of combustion control and furnace design. Reference was made to special designs of furnace incorporating means of adding "secondary" air, of preheating and mixing the air, of controlling the volume of air, of using fan-blown rather than steam-jet blown air, and so on. None of these methods and special furnaces met with much success, and other measures were tried, such as more uniform coal firing and even mechanical stoking when the type of re-heating allowed. The obvious development of mechanical stoking and uniform fuel feed was the use of pulverized fuel, and by 1929 some measure of success had resulted from the attempts to use this fuel in certain types of large forging and re-heating furnaces. It was claimed by some fuel technologists that the use of this fuel, by virtue of some measure of control over its rate of supply to the furnace, and its fine state of division, would make smokeless stack conditions possible.

In addition, specially prepared coal was tried. It was thought that if the volatiles which are first distilled from coal as it is heated were removed before the coal were used in the furnace, the main smoke-producing elements would be eliminated. Early works tests with this prepared coal, a type of lower temperature coke from which about 5% of the volatiles had been removed, indicated that good results might be obtained in certain types of furnace.

The Memorandum also recorded the success which had been obtained by the use of cleaned producer gas in place of direct coal firing for reheating, but also stated that producer gas-fired furnaces could only be considered economic when they were sufficiently large or in batteries. Also they were not economic where the steel production was intermittent, which is an outstanding feature of much of the work done in Sheffield. Also, although producer gas-fired furnaces may be reasonably smokeless over a period of a week, they give rise to large quantities of soot at the end of the week when the mains have to be cleaned out and the accumulated tarry matter removed by a process of burning.

Research.

During the period covered by this Memorandum of 1929, and during the following few years, much research work of practical chemical and metallurgical nature was being carried out. The scientific investigations were concerned with the action of gases on different types of steel and were expressly designed to test the age-long slogan that "black smoke is necessary for the proper heating of steels." As a matter of fact, much evidence was already available on this point, evidence produced by chemists and metallurgists both in this country and abroad, but laboratory experiments on which this evidence was based were regarded, as is usually the case, as not having much practical significance.

Some of the finest research work on this subject was carried out in the Fuel Department of Leeds University by Professor Cobb and his co-workers, who studied the action on mild steel of individual gases and mixtures of gases of the type produced by the combustion of various fuels.

As investigator to the Sheffield Steel Manufacturers' Smoke Abatement Research Committee, I was able to add in some measure to the work done at Leeds by conducting similar research on other steels, especially high carbon steels and special alloys such as high speed and stainless steels. In Sheffield we were privileged in getting very material practical assistance from the steel manufacturers themselves, and were able to build new designs of furnace on a proper works scale, embodying means of carrying out the knowledge gained in the laboratory.

The results of the work, both in the laboratory and in the steel works, were very definite and destined to have far-reaching effects.

The results, in brief, were as follows:

1. Black smoke is *not* essential to prevent surface damage to steels during heating.
2. Black smoke produced by the burning of coal in steel-heating furnaces is only an indication of reasonably correct furnace conditions, and serves no other useful purpose.
3. Black smoke cannot be avoided when coal is used in furnaces of antiquated designs, and is both difficult and costly to avoid in any coal-fired steel-heating furnace.
4. Surface damage to steels can be prevented, without the production of black smoke, by using furnaces designed to burn town gas.

This is not the occasion to give the metallurgical, chemical, and practical evidence in support of these results, but it is sufficient to say that it was accepted by the steel manufacturers and, needless to say, by the Local Authorities' Committee on Smoke Abatement. The final summary of the report submitted by the Chairman of the Joint Research Committee, Professor R. V. Wheeler, was as follows:

> "I am satisfied that so far as metallurgical processes are concerned, such processes can be carried out with suitable plant without excessive smoke. I do not think,

however, that it can be expected that manufacturers would agree to scrap existing plant which has cost thousands of pounds, to install new plant."

It will be obvious that the acceptance of such a statement by the steel manufacturers marked the beginning of a new outlook on the problem of metallurgical smoke.

From this time on, the question of the necessity for black smoke gave place to the fundamental questions of the cost of suitable plant and the cost of suitable fuels to use in it.

Gaseous Fuel for Industry.

Let us look now at the problem from an entirely different angle and see how the Gas Industry fits into the scheme.

The Sheffield and District Gas Company, since the beginning of the present century, has realized the possibilities of developing the use of town gas as a fuel for the steel industry. By virtue of persistent endeavour through its Industrial Department prior to 1914, and especially during the period 1914-18, it was shown that many of the lighter processes in the steel trade could be satisfactorily carried out in gas-heated furnaces.

Such was the demand for town gas towards the end of the last war, when everything in industry had the impetus of national emergency behind it, that supplies of coke oven gas were brought into the area to augment the normal production of gas by the Sheffield and District Gas Company. It was the experience gained during the war period and the years immediately following it, that began the appreciation of gas as a fuel for steel heating. In fact, such was this appreciation that the Memorandum of 1929, to which I previously referred, made notable mention of it. The following facts of the Memorandum may be quoted with advantage:

> "The most perfect control with the greatest flexibility in operation can be attained when gas of a constant quality is supplied at a constant pressure and is utilized in a properly designed furnace. The nearest approach to this is town gas (*i.e.*, coke oven gas) which is now being used increasingly for those heat treatment operations where the greatest care is necessary. A further advantage to be gained from the use of coke oven gas is that low-temperature operations which are normally responsible for heavy smoke emissions, are carried out smokelessly. It is not possible at the present time to say precisely what will be the full field of application for coke oven gas, since the use of it has so far been restricted on the score of price. The Area Gas Supply Committee which is at present investigating the problem of utilization of surplus coke oven gas has under consideration a scheme whereby in the comparatively near future it is hoped to make available this gas to the works at a cost which may make it attractive. It will be necessary before this gas can be used to its full advantage and contribute its full quota to reducing the present smoke emission, to undertake a great deal of development work in order to adapt the furnace designs to the metallurgical operations involved."

This quotation shows clearly the position in 1929. It shows that the steel manufacturers were already well aware of many of the advantages offered by using gas as a fuel, and also that they had great faith in the extended use of coke oven gas *provided it could be obtained at a sufficiently competitive price.*

As you already know, the Area Gas Supply Committee in 1930 vested in the Sheffield and District Gas Company the control of the South Yorkshire Gas Grid, the first gas grid in the country. The detailed account of its inception and development, its intrinsic value to the Sheffield steel industry and the coke oven industry has been given on other occasions, but I make no excuse for bringing to your notice some aspects of its contribution to the metallurgical smoke problem.

Now without any doubt the steel manufacturers did not propose to use coke oven gas because it was smokeless in operation. Their previous experience of its value, fostered over many years by the Gas Company, had proved to them it was the fuel of the future. At that time, 1931, the steel industry had undertaken a programme of rationalization and reorganization, following a period of great trade depression, this programme having been advocated and supported by the Government. World market conditions and intense foreign competition had put a premium on costs and quality of production, and it was imperative that the closest control be given to all factors bearing on these two main items. In addition, the development of new steels, and the rigid specifications demanded by all branches of engineering, made it essential to give the greatest care to each process of fabrication, and the use of fuels naturally received detailed consideration.

Competitive Pricing.

It was natural then that attention be focused on the newly formed Gas Grid. First of all, what price would be asked for coke oven gas? Leaders of the steel industry and fuel technologists put forward much evidence of the costs of the most commonly used fuels—coal and producer gas—and it was shown that coal was costing as little as 0·5d. to 0·75d. per therm, while producer gas, in well-operated plants, cost only 1·25d. per therm. This evidence of cost was considered most carefully by the Sheffield and District Gas Company, who have always shown a keen appreciation of the need of the steel industry for a cheap fuel, and the gas was therefore fixed at such a price as to be practically competitive with coal and producer gas on a thermal basis. This first price, for guaranteed contracts for supply of 30 million cu.ft. per year, was only 1s. per 1,000 cu.ft., or 2·4d. per therm.

This price interested the steel manufacturers.

Contracts were taken out for supplies of 30 million cu.ft. per year by several firms. Contracts were exceeded and larger contracts made in successive years. New firms took out contracts as soon as opportunity allowed. In 1931 eleven firms were taking contract gas, and the gas used in that year for steel heating was 2,367 million cu.ft.

In 1932 the amount had increased to 2,575 million; in 1933 to 2,943 million; in 1934 to 3,686 million; in 1935 to 4,298 million; in 1936 to 5,565 million; and in 1937 to 6,981 million cu.ft. The past year, 1938, showed a still further increase.

In short, the amount of gas used for industrial heating purposes *alone* has increased by 4,614 million cu.ft. in six years, or, if you like, by an amount almost equivalent to the combined total sales for all purposes of both Leeds and Bradford in 1937.

For what particular processes has this gas been used? An examination of the long list of varied heating processes in steel fabrication carried out in gas heated furnaces shows most clearly that it has been principally for those very processes for which previously black smoke was deemed necessary.

The firms taking the huge contracts for gas are principally engaged in the "heavy" section of the steel industry; in the melting of steel, in the forging and rolling of large ingots and billets into such items as shafting for ships' propellers, turbine rotor shafts, gun tubes, rail and tram track, boiler drums, hollow forgings for high pressure work, and bars and sheets of all sections, &c. In general, they are concerned with the reheating of steel to receive mechanical work to change its shape, and with annealing to give it the required quality.

It is in those processes, especially annealing, where black smoke used to be formed in order to prevent scaling and surface damage. Before gas heated furnaces were used for this work, thousands of tons of coal were used per week in Sheffield in furnaces operated in a manner designed to produce smoke. Now, millions of cubic feet of gas are used per week instead in furnaces which emit no smoke whatever. One firm alone used 700 million cu.ft. of gas in 1935, and, to quote the fuel technologist of that firm, "this gas is replacing over 40,000 tons of coal per year, by no means a slight contribution to the favourable solution of the smoke question." This firm to-day is using over 1,600 million cu.ft. of gas.

There are actually 24 firms in Sheffield taking contract gas for similar work who consumed in 1937 more than 4,000 million cu.ft. of gas, and simple calculation will indicate that this gas is replacing, on a fair estimate, 240,000 tons of coal per annum, in the "heavy" section alone of the local steel industry. A more interesting calculation, however, can be made, if we consider the cost of coal and gas. If the estimate is correct, made by the fuel technologist referred to earlier, that 700 million cu.ft. of gas replaces 40,000 tons of coal, this means that 3½ million therms of gas does the same work as 12 million therms of coal, which in turn means that

the effective price of gas sold at 2·4d. per therm, is actually only 0·7d. per therm on a coal cost basis.

This figure of 0·7d. is, as a matter of fact, about the price which was paid for coal in 1931. To-day it is 0·8d., or £1 per ton, allowing 300 therms to the ton.

A fuel technologist of a Sheffield steel firm whose annual bill for fuel is nearly £250,000 said quite recently that gas at 1s. a thousand cubic feet compares favourably with coal at 1s. a hundredweight for steel heating.

You will see, then, that the gas sold through the South Yorkshire Gas Grid is truly competitive with raw coal, and on that score alone makes its primary and fundamental appeal to manufacturers.

In addition to comparison on a thermal basis, which is the only one in which manufacturers *profess* any interest, there are other factors of even greater economic importance. Take scale prevention, for example. A saving of only 1% of metal by reducing scale formation means a money saving of 2s. per ton with steel costing as little as £10 per ton. The firm I have previously mentioned as having a loss of 9% of metal due to scaling in coal fired furnaces now only loses 6% as scale in gas furnaces, and as the metal they heat is one costing about £200 per ton, the direct saving in this case is actually £6 per ton of metal. In this example, the cost of heating and reheating a ton of steel is only 15s. when using gas. Yet another firm, dealing with cheaper steels, admits that saving due to reduction in scale formation pays more than half the gas bill, which is at least £12,000 per year.

Leaving those items which can be readily computed as pounds, shillings, and pence, there are others of wider significance. The use of gas heated furnaces has allowed steel to be heated with the same scientific precision as is used in determining its metallurgical characteristics, with the result that any departure from a high standard of quality can be traced and put right by the adjustment of a precision control instrument for temperature, or furnace atmosphere.

If time allowed, it would be interesting to show you how the control of gas fired furnaces for all the reheating and heat treatment processes in the steel trade has helped, in no small measure not only to maintain quality and rate of output, but also to improve them.

I could add also that the Sheffield and District Gas Company's service to consumers, through its Industrial and Research Departments, has been esteemed by both large and smaller firms in the area, and had it not been for the practical and technical assistance given in many cases, certain firms would have been much longer in being able to take advantage of the cheap gas offered through the Grid.

Present-Day Position in Sheffield.

Since it has been realized that black smoke is not essential for production of steels, the Sheffield, Rotherham, and District Smoke Abatement Committee has been very active in watching the progress made to install new types of furnace and new types of fuel, particularly coke oven gas.

Two years ago it made application to the Ministry of Health to reconsider the provisional exemption made in the 1926 Public Health Smoke Abatement Act, and which is now included in the Public Health Act, 1936, the latest legislation on smoke pollution. The steel manufacturers are very much against the removal of the exemption claims, and so a further survey of the industry has been made during 1938 by the Technical Department of the Iron and Steel Federation. The report submitted on the results of this survey is most definite on the valuable contribution made by the use of coke oven gas towards solving the smoke problem—in fact, gas is given first place in the list of factors having influence on the abolition of smoke.

Emphasis is given to the outlay of capital necessary to install modern furnaces and four firms are cited as having an expenditure of £1,000,000 to this end. It is claimed that this expenditure is directed to smoke mitigation, which, of course, is nonsense. It is to increase output, improve quality, and reduce over-all costs. That a contribution to the abatement of smoke has been made at the same time is merely a happy and fortunate consequence, well worthy of proper mention, but not to be claimed as a philanthropic act on the part of fuel users. Attention is also drawn to the increasing use of pulverized fuel and, again, this is not due to any great desire to reduce the smoke pall, but simply to the fact that the demand for coke oven gas is greater than the present supply from the coke ovens.

Cost figures of pulverized fuel recently made available to me show that the cost per therm of pulverized fuel is of the same order as the cost of producer gas—namely, 1·25d. per therm—but it has difficulties in use which probably call for greater care even than untreated coal.

The ever-increasing demand for coke oven gas is actually becoming embarrassing, and further supplies will, if necessary, have to come from the coke ovens already operating through the Grid, or the area from which the Grid can collect its gas will have to be extended.

This section of the Paper can most suitably conclude with a quotation from the 1938 Annual Report of the Chief Smoke Inspector for Sheffield:

> "Eventually the demand . . . will probably result in the introduction of gaseous fuel-fired furnaces throughout the industry, then one of the principal sources of pollution will have disappeared."

Conclusion.

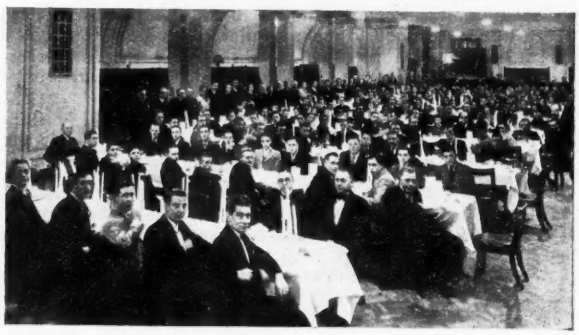
I have tried to give you in as brief space as possible some idea of the problem of metallurgical smoke abatement. Most aspects have been mentioned, but I am quite sure you will have gathered that it is a problem governed principally by a proper consideration of the economics of metallurgical practice.

It is tempting to end by generalizing on the smoke problem as a whole, to include both industrial and domestic smoke. Legislation has proved to be so difficult of attainment in the field of industrial usage of fuels that it is reasonable to suppose that any attempt to introduce legislation regarding domestic smoke might be even more difficult. The domestic smoke problem is at bottom the same as the industrial smoke problem—a question of costs of alternative fuels and the plant in which they can be burned. Make these economically attractive. Sufficiently attractive that they interest the 90% of this country's working population who receive less than £5 per week as income, and you will, in my opinion, have made the most practical contribution yet to rid the country of the smoke evil.

Athletic and Social

A Christmas Dinner.

This photograph was taken at the annual Christmas dinner of the staff, workpeople, and friends of the firm of Donald Macpherson & Co., Ltd. This enjoyable function, held recently



at the Manchester Limited Restaurant, was attended by over 300 persons, including Mr. W. A. Lowe and Mr. S. W. Chester, Directors of the Company.

Narborough Dinner.

The annual dinner of the employees and staff of the Narborough Gas Company was held at the Bull's Head Hotel, Whetstone, on Jan. 12. Mr. E. M. Frost, General Manager, presided. He thought his Directors had acted quite rightly in treating with the Corporation for the sale of their Gas Undertaking, and he was sure that all present wished the Corporation Gas Department every success in this new venture.

Mr. H. Potter, Blaby's representative on the District Council, and Mr. Thomas Laundon, who had served the Company for over fifty years, attended.

British Sulphate of Ammonia Federation

Annual Report for 1937-38

The following figures are offered as fair estimates, but strict accuracy is not claimed for them. The estimates for 1935-36 and 1936-37 have been slightly revised. The percentage increases or decreases as compared with the previous year are shown in italics.

World Production and Consumption of Pure Nitrogen for the Fertilizer Years Ended June 30.

[In Thousands of Metric Tons.]

Production.	1935–36.	1936–37.	1937–38.
Sulphate of ammonia—			
Synthetic	630	688	765*
By-product	376	429*	411
	1,006	1,117	1,176*
Cyanamide	269	291	305*
Nitrate of lime	156	179	195*
Other forms of nitrogen†—			
Synthetic	724	851	931*
By-product	46	53	49
Chile nitrate	192	206	224
Total production	2,393	2,697	2,880*
Percentage increase or decrease	*+ 15·6*	*+ 12·7*	*+ 6·8*
Consumption—			
Manufactured nitrogen	2,223	2,492	2,620*
Chile nitrate	218	238	252
Total consumption	2,441	2,730	2,872*
Percentage increase or decrease	*+ 17·8*	*+ 11·9*	*+ 5·2*
Agricultural consumption about	2,106	2,369	2,492*
Percentage increase or decrease	*+ 16·2*	*+ 12·5*	*+ 5·2*

* Highest figure ever reached.

† Including nitrogen products used for industrial purposes (except Chile nitrate) and ammonia in mixed fertilizers.

NOTE.—Fertilizers are included in these tables under the final form as sold, so that, for example, cyanamide if converted into sulphate of ammonia is included under synthetic sulphate of ammonia, or, if into ammophos, under other synthetic nitrogen.

During the year under review it is estimated that there was an increase of 183,000 metric tons of nitrogen, or about 6·8%, in the actual production of the forms of nitrogen enumerated above. The production in Chile increased by 18,000 tons, or 9%, and output in other countries increased by 165,000 tons, or 7%. As indicated by the asterisks, 1937-38 was a record year for the output of most of the products shown.

As in the previous year, the most marked increases in the output of manufactured nitrogen have been in Germany and the Japanese Empire; but in the U.S.A. there was a decrease.

Synthetic nitrogen plants have on an average operated at only about 53% of capacity during the year; the world production capacity for synthetic nitrogen, including cyanamide, is estimated at roughly 4,100,000 tons of nitrogen.

The total consumption increased by 141,678 tons, or about 5·2%, following an increase of 11·9% last year.

The increase in fertilizer nitrogen consumption was 123,000 metric tons, or 5·2% as compared with 12·5% in the previous year. Each main class of fertilizer showed an increase; ammonium sulphate (including ammonia for mixed fertilizers) increased by 59,421 tons of nitrogen, or 5·1% over the 1936-37 figure, Chile nitrate by 14,122 tons (5·9%), calcium cyanamide by 10,503 tons (3·7%), and "other synthetic nitrogen fertilizers" by 52,780 tons (7·5%).

In individual countries the largest tonnage changes in fertilizer nitrogen consumption have been increases in Germany, the Japanese Empire, Spain and Italy, and decreases in the U.S.A. and China. The Spanish consumption is, however, still far below its peace-time level; and in China most of the large advance made in 1936-37 has been lost.

The increase in consumption in Europe is very impressive—141,659 tons N for fertilizer nitrogen alone. Almost half of this was due to Germany, which also accounted for about half of the European increase in ammonium sulphate and three-quarters of that in other synthetic nitrogen fertilizers. Of the decrease in the consumption of fertilizer nitrogen in the American Continent (35,459 tons N) about 90% was in the U.S.A.

The order of importance in the production and consumption of nitrogen for agricultural use remains roughly as in recent years, viz.: Ammonium sulphate, 47-48% of all fertilizer nitrogen; cyanamide, 12%, Chile nitrate, 9-10%; lime ammonium nitrate ("Nitro-chalk" forms), 9-10%; calcium nitrate, 7-8%; sodium nitrate (for fertilizers), 3%; and other synthetic nitrogenous fertilizers, 11-12%.

The international agreements mentioned in earlier Reports have been renewed for a further period of 3-5 years.

Home Production.

The figures in the following table showing the total production of ammonia products, expressed as sulphate, are calculated on the basis of 25% ammonia (about 20·6% nitrogen). The figures for sulphate of ammonia production, however, apply to actual tons of product with a nitrogen content varying from an average of about 20% in the earlier years to about 21% in recent years.

Production of Ammonia Products and of Ammonium Sulphate in the British Isles.

[Tons of 2,240 lb.]

Calendar Year.	Total Production of Ammonia Products, Expressed as Sulphate of Ammonia Equivalent (Basis 25% Ammonia).*				Included in the Total.	
	England and Wales.	Scotland.	Ireland.	Total Great Britain and Ireland.	Industrial Ammonia Products (Basis 25% Ammonia) about	Sulphate of Ammonia as such (Actual Tons of Product) about
1935	560,835	47,650	4,064†	612,549	113,500	448,300
1936	562,380	49,703	4,006†	616,089	117,600	426,700
1937	642,720	51,730	3,940†	698,390	116,800	504,900

* The figures for total production of ammonia products are recalculated from the Alkali Inspectors' Reports, except for the estimates shown. Estimates for Ireland have been included.

† Estimated.

Home consumption of sulphate of ammonia showed an increase on the 1936-37 figures of 1,300 tons, or 0·6%, following an increase of 2·1% in the previous year. Prices were 9s. per ton higher than in the previous year. The increase in the consumption in England and Wales was 3·5% and in Scotland 1·4%, but in Ireland there was a decrease of 9·4%.

The detailed figures are given below. Estimates for a few earlier years have been slightly revised:

Great Britain and Ireland and Channel Islands.

[Tons of 2,240 lb.]

Fertilizer Year (a).	Total Production of Sulphate of Ammonia for Sale as Such.	Agricultural Consumption of Sulphate of Ammonia in—				Agricultural Consumption of Chile Nitrate (e).	Sulphate of Ammonia.	
		England, Wales, and Channel Islands.	Scotland.	Ireland.	Total British Isles and Channel Islands.		Exports from—	Imports into—
							Great Britain and Ireland other than to or from the Channel Islands.	
1935–36	411,000	133,500	46,000	40,200	219,700	34,000	199,444	4
1936–37	478,000	133,300	48,400	42,700	224,400	36,000	243,973	4,799
1937–38	534,000	137,900	49,100	38,700	225,700	35,000	288,508	0

(a) Year ended June 30.

(e) Estimated.

N.B.—The total consumption of Chile nitrate is estimated at 45 000 tons as against 43,000 tons for last season.

The total consumption of pure nitrogen in the British Isles for agricultural purposes amounted to about 68,200 metric tons against 65,700 tons last year, an increase of 3·8%.

Exports.

Total exports of ammonium sulphate from Great Britain and Ireland show an increase of 44,711 tons or about 18% on last year's figures.

The following figures show the shipments to the principal markets:

	1935–36.	1936–37.	1937–38.
Spain, Portugal, Canaries	33,254	40,008	39,921
Japan	201	—	—
China and Hong Kong	12,221	36,726	41,194
West Indies, British Guiana, and Mauritius	34,626	39,557	41,671
India and Ceylon	58,621	57,502	65,547
Australia and New Zealand	30,634	27,884	32,254
South and East Africa	9,556	9,900	16,689
Malaya	8,624	20,302	32,128

Propaganda Work.

The agricultural price index for Great Britain for the year under review averaged 135 as compared with 132 for the previous year, these figures including allowances for the wheat and beef subsidies. On the whole, the year cannot be regarded with satisfaction from the agricultural point of view, the position being undoubtedly worse than that indicated by the above comparison.

In Great Britain the land fertility scheme became operative from September onwards and thereafter all purchasers of lime and basic slag from approved suppliers qualified for the subsidies offered (50% on lime and 25% on basic slag). During the year there were nearly a quarter of a million applications for contributions under the scheme covering almost 1½ million tons of lime and very nearly half a million tons of basic slag. It is thought that the increased use of lime must eventually benefit the sales of sulphate of ammonia, and there has been little to support any fears that the farmer's expenditure on subsidized materials might limit his use of other fertilizers.

The absence of sunshine in July, 1937, hampered haymaking to some extent, but subsequent warm and dry weather enabled harvests to be satisfactorily completed by the end of September. Winter-sown crops germinated well, but serious floods caused much damage in East Anglia. In the spring of 1938 occurred one of the longest droughts on record, resulting in a light hay crop and widespread shortage of pasture. The opportunity was taken of launching a special publicity campaign urging farmers to repair the damages of drought with nitrogenous fertilizers. It is estimated that hay stocks were reduced from 4,800,000 tons on Jan. 1 to 836,000 on June 1. During the year the country experienced the most serious outbreak of foot and mouth disease during the present century, 268 cases in 20 counties being notified between October, 1937, and March, 1938.

No fundamental changes have occurred in the organization of Agricultural Marketing. The postponement of the legislation to give effect to the proposals of the White Paper on Milk was the cause of some disappointment. The annual report of the Potato Marketing Board recorded that growers' prices were maintained at a more satisfactory level than that ruling during similar seasons before the appointment of the Board. The proposed legislation to amend the Wheat Act to provide in particular for periodical reviews of the standard price was postponed until after the Recess. The Bacon Development Board has been strengthened. The poultry industry continued to cause anxiety, and the serious economic condition of this branch of farming showed no signs of improving; legislation in some form is envisaged.

Sulphate of ammonia has been prominently displayed both on I.C.I. stands and agents' stands at most of the principal shows throughout the country. Many lectures were given as usual during the winter months. Press publicity has been considerably extended and new publications on sulphate of ammonia widely distributed.

During the year an extensive and detailed survey of the possibilities of the development of soils and fertilizers for cotton in India was completed. The report indicates possibilities for developing the use of sulphate of ammonia on cotton in certain irrigated tracts, and the local organization is actively pursuing this matter.

The rubber experiments in Malaya which were brought to a close last year continue to exercise a beneficial influence on sales. In several other countries we have continued to support experimental work, and the local selling organizations regularly carry out propaganda work in co-operation with agricultural bodies.

Membership.

At June 30, 1938, another quadrennial period was completed. One small producing Member and ten Members who had ceased production resigned from the Federation. The Membership was further reduced by six, due to amalgamations within the industry. Four new Members joined during the year, which closed with a total of 192 Members, who continue into the current period.

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TRADE NEWS

"Main" Broadsheet Features Their New Cooker Programme.

In advance of the issue of their new cooker catalogue in March, Messrs. R. & A. Main, Ltd., are using a refreshing means to introduce their latest cooker productions to the Gas Industry.

The Main Times

GOOD NEWS FOR SALES STAFFS

Fresh Cooker Programme for the New Season

The No. 57 Main Cook

The Nos. 57 and 527 Cookers Pictured in Kitchen Settings

A useful Main "Extra" for the New Cookers

Two Pages from "The Main Times."

They are achieving this by circulating "The Main Times," a broadsheet which features the new No. 57 "cabinet" high-grade type, and the No. 527 "streamlined" intermediate type cookers.

In format not unlike the picture-newspaper of to-day, "The Main Times" presents the story of the design and construction of both models in complete detail, and illustrates the cookers not only in their standard forms with hinged covers but also with various alternatives to the current fashion of "folding tops."

Messrs. Fletcher, Russell, & Co., Ltd., Representation.

Messrs. Fletcher, Russell, & Co., Ltd., announce the appointment of Mr. L. F. King as their Representative for the Southern and South-Eastern Area. Mr. King succeeds Mr. Frank Berry, who, it will be remembered, was one of the victims in the recent Jersey Airways disaster.

Mr. G. R. Hobson has been appointed as the firm's Representative for the North-Eastern and Eastern Area, in succession to Mr. King.

"Cambridge" Thermo-Electric Pyrometers.

Industrial pyrometry may be said to have started with the introduction by Professor H. L. Callendar in 1899 of his well-known recorder. Of the first six Callendar recorders constructed by the Cambridge Instrument Company, Ltd., 13, Grosvenor Place, S.W. 1, some are still in regular use. Since then, the firm state in a recent coloured folder, all further advances in the accurate measurement of temperature have been reflected in the development of "Cambridge" temperature measuring instruments. This folder deals with thermo-electric pyrometers of the latest design, incorporating the cumulative experience of forty years.

Turner and Newall, Ltd.

The annual report of Messrs. Turner & Newall, Ltd., manufacturers of insulating materials, asbestos goods, &c., states that trading profits and dividends from subsidiaries at £1,650,386 show an increase of £106,510 over the previous year. After providing £130,693 for depreciation, against £122,117, £154,749 for income-tax, against £85,164, and £84,000 for N.D.C., against £40,000, net profit is lower at £1,277,694. As previously announced the dividend is unchanged at 20%. General reserve again takes £100,000 and the Welfare Trust £10,000, leaving £116,610 to be carried forward, against £115,770 brought in.

Considerable sums have been provided, in the form of additional share capital, to finance the building of two additional asbestos cement factories at Calcutta and Bombay of the Indian subsidiary, Asbestos Cement, Ltd. Capital was also provided in connexion with the opening of the Havelock asbestos mine in Swaziland, under the direction of New Amianthus Mines, Ltd.

Newcastle Lose Coal Appeal

Prices Found "Fair and Equitable"

The Durham District Investigation Committee under the Coal Mines Schemes gave its findings in Newcastle on Friday on the enquiry into the complaint brought by the Newcastle-upon-Tyne and Gateshead Gas Company that prices fixed by the Durham Coal Sales Control Committee in respect of 1939 contracts for supplies of Durham gas coal were unduly high and showed discrimination compared with prices charged for similar coal supplied to London gas undertakings.

The Investigation Committee found that the prices were fair, equitable, and not contrary to the public interest, and it was unanimous that no case had been made out for an alteration of the Durham selling scheme. The Committee comprised Colonel H. G. Faber, Chairman; Mr. J. R. Ropner and Mr. Gerald Newall, representing consumers; Mr. S. E. D. Wilson, Chairman of the Durham Executive Board under the coal mines schemes; Mr. Sam Watson, Treasurer of the Durham Miners' Association, and Lieut.-Colonel J. G. Coulthred Thompson, Secretary of the Committee.

The hearing occupied three days during which Mr. C. B. Fenwick, for the complainants, submitted evidence supporting his contention that it was unfair that contracts made with London undertakings on an f.o.b. basis showed an equivalent pithead price of 17s. 3d. a ton while complainants were paying 18s. 6d. a ton at the pithead for the same class of coal—Durham Class B. He urged that the Coal Schemes be modified to remove anomalies between seaborne and rail or road borne prices. Dr. J. Charlesworth, for the Durham Executive Board, the respondents, submitted that the prices fixed were fair and equitable.

Announcing the Investigation Committee's decision, the Chairman said they found that (*a*) the prices fixed by the Durham Sales Control Committee of 19s. 3d. for Class A2, 18s. 6d. for Class B, and 18s. for Class C unscreened Durham gas coal for sales to complainants for delivery over 1939 were fair, equitable, and not contrary to the public interest. (*b*) It was found that complainants had not been prejudiced or injuriously affected by such pithead prices as compared with the pithead prices paid by other public utility undertakings, including gas undertakings situated in the Durham district which purchased Durham coals that were conveyed by road or rail. (*c*) As compared with the pithead prices fixed for coal supplied to complainants, the Committee were satisfied that other public utility undertakings in the Durham district were paying as large, and in certain cases larger, increases per ton in the pithead prices for Durham coal supplied to them for delivery over 1939 compared with prices paid for similar coal in 1935. (*d*) The delivered prices paid by the complainants were less than the delivered prices for similar coal paid by other gas undertakings whose works were situated in Durham district and who carbonized not less than 50,000 tons of Durham coal a year. The Committee further stated that they considered

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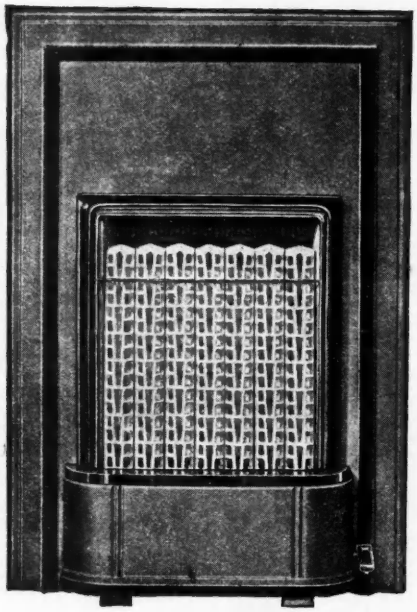

Literature obtainable on request.

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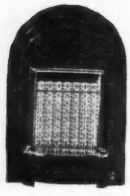

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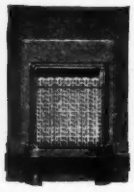

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No. 1557 FIRE PRINCESS

that coal sold to the gas undertakings on Thames-side were properly included in a different class (that was, Class 2 of the Gas Section of the Classification and Minimum Prices List as determined by the Durham Executive Board) from the coal sold to the complainants.

The former coal, being sold or destined for shipment, was, in the opinion of the Committee, correctly placed in such a different class of coal used for gas-making purposes only, in accordance with Section 96 (1) of the Durham District (Coal Mines) Scheme, 1930.

They were also of the opinion that different considerations must necessarily apply to the fixation of the price of coal sold or destined for shipment from that of coal passing by rail or road. They recognized that the fixation of a uniform pithead price for coal destined for shipment would show different f.o.b. prices with the result that colliery companies, with long rail leads to the point of shipment, would be excluded from the export and coastwise trades, which were of such importance to the Durham coal industry and would, furthermore, prevent the Durham Sales Control Committee from carrying out the duties imposed upon them by Section 91 of the scheme which provided that the Sales Committee should so regulate the sale and supply of coal as to ensure, as far as possible, equitable distribution among the coal owners, of the market requirements of coal.

The Committee agreed with the Sales Committee that one of the most important considerations to be borne in mind in fixing prices was the necessity of obtaining proceeds which would, at least, result in the payment of wages 70% above the basic rates.

By a majority the Committee were not prepared to make any recommendation to the Executive Board as to the prices complained of. The Committee were unanimously of the opinion that no case had been made out for an alteration of the scheme. The only object of any alteration, apparently, would be to introduce more rigidity into the scheme and this, the Committee felt, was inadvisable.

They were also of the opinion that elasticity in a scheme of this nature was of very considerable value and were satisfied that the means open to consumers in order to obtain redress for any grievances due to the operation of the scheme were sufficient as matters now stood. The Committee were not therefore prepared to make any report to the Board of Trade on this point. This concluded the investigation.

During the hearing, it will be recalled, Mr. T. P. Ridley, Secretary and General Manager of the Company, mentioned in evidence that were the prices fixed upheld, it would involve an increase in costs of about £40,000 and if the Company delayed passing it on to the consumers they would have to meet it out of their reserves.

World Power Conference

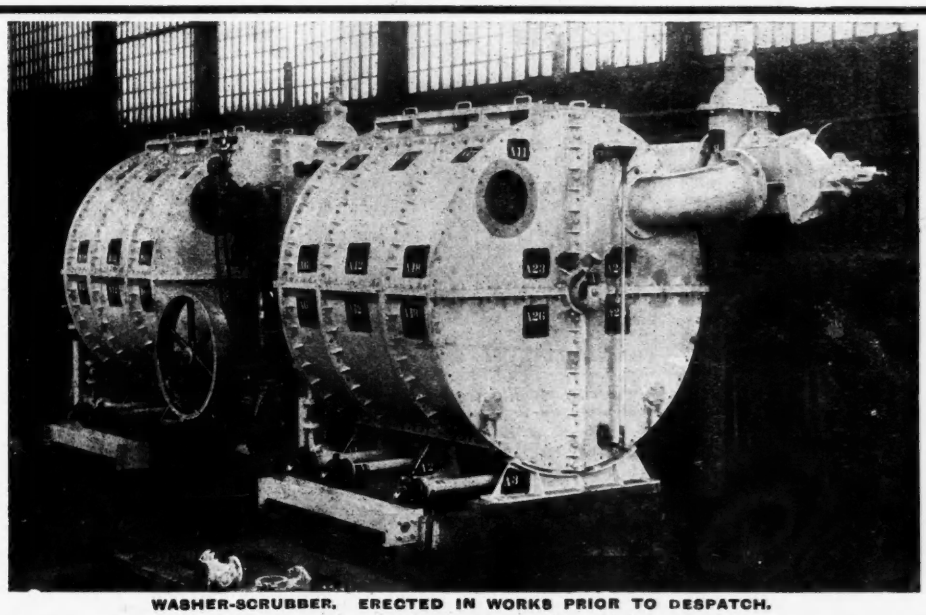
Statistical Year-Book

The Statistical Year-Book, now in its third year of publication, represents an attempt by the World Power Conference to compile and publish international statistics of power resources, development, and utilization upon a comprehensive and comparable basis.

The task of preparing the tables and, above all, the definitions of the terms employed, lasted just ten years. Experts in many countries were consulted through the National Committees of the World Power Conference, and a special Sub-Committee of the International Executive Council under the Chairmanship of Mr. O. C. Merrill (United States) held a number of Sessions in 1932 and 1933. The definitions are reproduced in the text.

The Statistical Year-Book, No. 3, contains an inventory, based on the latest available official and semi-official information, of the fuel and power resources of the different countries, and annual statistics, relating to 1935 and 1936, of the production, stocks, imports, exports, and consumption of coal, brown coal and lignite, peat, coke, other manufactured solid fuel, wood, petroleum, benzoles, alcohols, natural gas, manufactured gas, water power, and electricity. Statistics for about sixty countries are included, and, where practicable, continental and world totals are presented. The great majority of the statistics were specially compiled by the National Committees of the World Power Conference with the assistance of Government Departments and other organizations, and the use of the uniform tables and definitions adopted by the World Power Conference has ensured a high degree of comparability. Much of the information presented has not been published before.

Statistical Year-Book, No. 3, edited by Frederick Brown, is published by the Central Office of the World Power Conference, 36, Kingsway, W.C. 2, price 20s. net.



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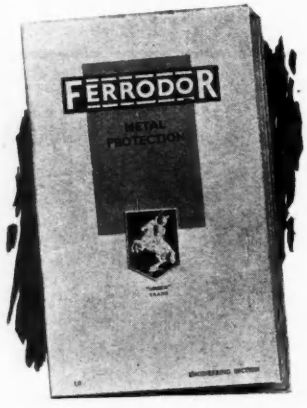

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Markets and Manufactures

Current Sales of Gas Products

The London Market

Jan. 16.

There is little of interest to record in the values of Tar Products, to-day's prices being as under:

Pitch, nominal at about 30s. per ton f.o.b.
Creosote, about 3½d. to 4d.
Refined tar, 3¾d.
Pure toluole, about 2s. 3d.
Pure benzole, about 1s. 9d.
95/160 solvent naphtha, 1s. 7d. to 1s. 8d.
90/160 pyridine, 10s.
All per gallon naked at makers' works.

The Provinces

Jan. 16.

Crude Gas-Works Tar, 14s. to 19s.

To avoid misunderstanding, it is necessary to state that the above price is not claimed to represent a market value. It is a price worked out from week to week upon a system which has been used for many years as a basis for the fixing of certain contracts for crude tar of varying qualities in different areas.

The average prices of gas-works products during the week were: Pitch—East Coast, 29s. to 30s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 29s. to 30s.* Toluole, naked, North, 1s. 7½d. to 1s. 9d. Coal tar, crude naphtha, in bulk, North, 7¾d. to 8¼d. Solvent naphtha, naked, North, 1s. 4½d. to 1s. 5d. Heavy naphtha, North, 1s. 2¼d. to 1s. 3d. Creosote, *ex* works, in bulk, North, liquid and salty, 4¾d. to 4⅞d.; low gravity, 4½d. to 4¾d. Carbolic acid, 60's, 1s. 7d. to 1s. 10d. Naphthalene, £13 10s. to £16. Salts, 70s. to 75s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal; "B" quality unsaleable. Heavy oil; Unfiltered anthracene oil, min. gr. 1,080, 4¾d. to 4⅞d.; filtered anthracene oil, min. gr. 1,080, 5¼d. to 5½d.; heavy tar oil, gr. less than 1,080, 4½d. to 4¾d.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Scotland

GLASGOW, *Jan.* 14.

Market is still suffering from a lack of orders but, nevertheless, prices are maintained at previous levels.

Crude gas-works tar.—Actual value is about 34s. to 35s. per ton *ex* works in bulk.

Pitch of vertical quality is obtainable at 21s. to 22s. per ton f.o.b. for export and round 20s. per ton *ex* works in bulk for home trade.

Refined tar.—Very little business is now being arranged in the home market, but quotations are unchanged at 3¾d. to 4d. per gallon. For export supplies can be secured at round 2¾d. to 3d. per gallon, both into buyers' packages at makers' works.

Creosote oil.—Some forward buying is taking place with values unchanged as under: Specification oil, 3¾d. to 4d. per gallon; low gravity, 4¼d. to 4¾d. per gallon; neutral oil, 3¾d. to 4¼d. per gallon; all *ex* works in bulk.

Cresylic acid.—Very little interest is being taken in this product with prices nominal as under: Pale, 97/99%, 1s. 2d. to 1s. 3d. per gallon; dark, 97/99%, 1s. to 1s. 1d. per gallon; and pale, 99/100%, 1s. 4d. to 1s. 7d. per gallon, all according to quality *ex* works in buyers' packages.

Crude naphtha continues to command 5½d. to 6d. per gallon *ex* works in bulk, according to quality.

Solvent naphtha.—90/160 grade is 1s. 3½d. to 1s. 4d. per gallon and 90/190 heavy naphtha is round 1s. 1d. to 1s. 1½d. per gallon.

Motor benzole is 1s. 3d. to 1s. 4d. per gallon.

Pyridine.—To-day's prices are firmer with 90/160 grade at 8s. 6d. to 9s. 6d. per gallon and 90/140 grade at 9s. 6d. to 10s. 6d. per gallon.

Benzole Prices

These are considered to be the market prices for benzole at the present time:

	s.	d.		s.	d.	
Crude benzole..	0	9½	to 0	10		per gall. at works
Motor „ ..	1	3	„ 1	3½		„ „ „
90% „ ..	1	4	„ 1	4½		„ „ „
Pure „ ..	1	8	„ 1	8½		„ „

Contracts Advertised To-Day

Resetting Retorts.

Sowerby Bridge Gas Department. [p. 190.]

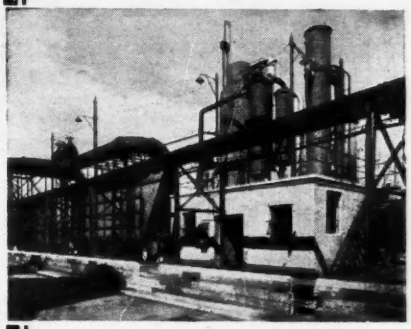
Stores.

Stockport Gas Department. [p. 190.]

Bilston Gas Light and Coke Company

In the ninety-third annual report and statement of accounts the Directors of Bilston Gas Light and Coke Company, Ltd., state that the profit and loss account, after paying the interim dividends, shows a credit balance of £15,740 12s. 1d. It was proposed to pay on Jan. 2, 1939, further dividends of 6s. per share on the "A" shares, less tax, and 4s. 6d. on the "B" shares, less tax (making with the interim dividends paid in July last 12s. and 9s. per share respectively for the year), leaving the balance to be carried forward. No increase has been made in the standard price of gas sold by the Company during the last few years notwithstanding increase in the cost of coal, wages, and in other directions. In view of this fact the Directors consider the results of the year's trading to be very satisfactory. Considerable capital has been and is being expended on the installation of high-pressure mains to points in Bilston and Coxley, and on other works, authority having been given to raise the further capital for this purpose. Mr. F. C. Briggs has been appointed to fill the vacancy on the Board occasioned by the retirement of Mr. T. B. Andrews.

Every Joint Sound!



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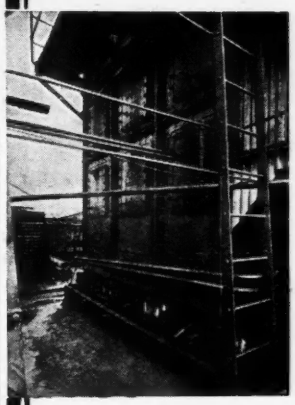

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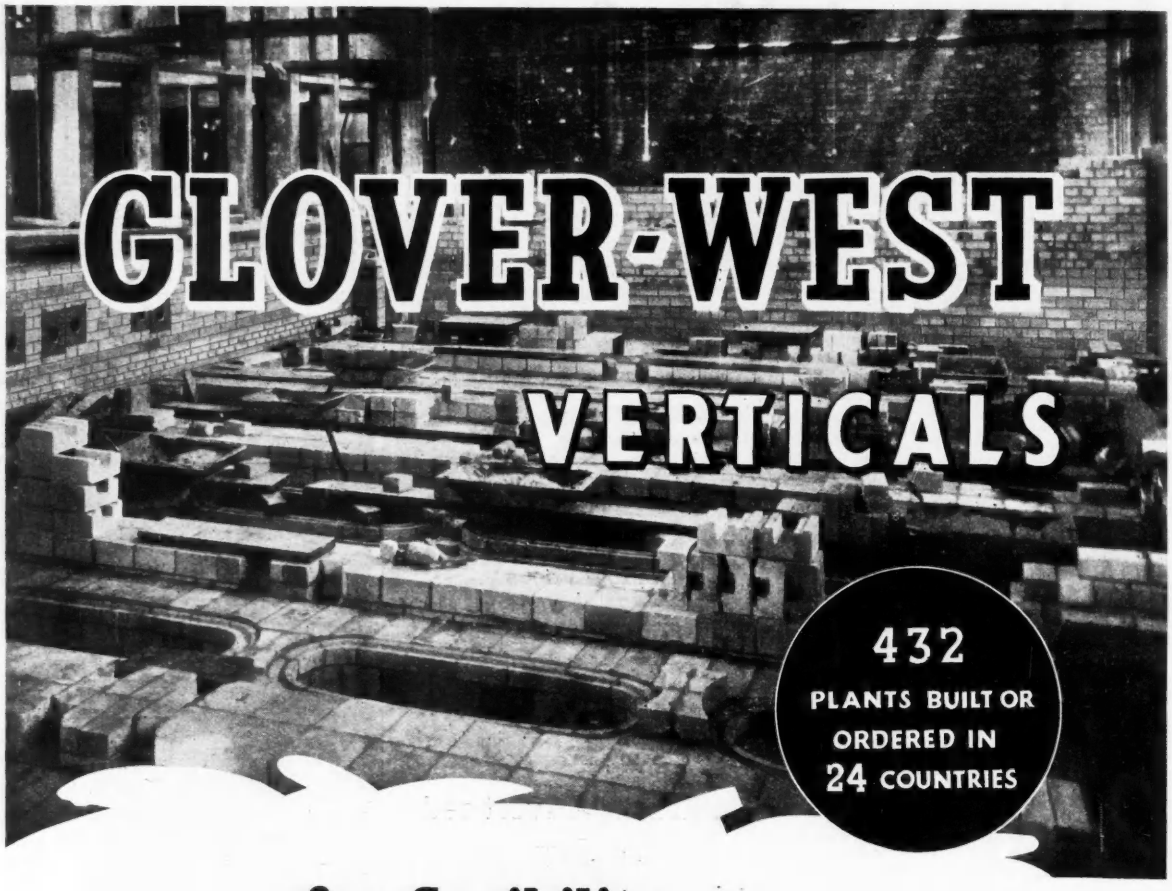

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GAS STOCKS AND SHARES

The volume of business on the Stock Exchange last week was again very small. Prices were fairly well maintained until Thursday, when weakness developed and markets closed in a reactionary condition. British Funds lost much of their earlier gains, though prices at the finish were higher than a week ago.

Despite the success of the Southern debenture issue, the opening premium on which subsequently disappeared, and the announcement by the L.P.T.B. of increased fares, home rails continued under a cloud with prices weakening. The industrial market was also heavy, though a rally in Americans towards the end of the week helped to steady prices. Foreign selling was responsible for the dulness of oil and gold mining shares, while rubbers remained idle. Altogether a most unsatisfactory week.

Conditions in the Gas market, in one respect at any rate, were in contrast to the general trend, as comparatively long lists of recorded transactions appeared each day. It will be seen below that several quotations were changed—the increases in value nearly balancing the decreases—though on the whole prices remained steady. Gas Light units weakened 3d. to 22s. 6d., and several of the Company's fixed-interest stocks also closed lower. British, Croydon, and Wandsworth "ordinaries" all dropped a point. On the other hand, Imperial Continental continued its upward trend, but the increase last week was limited to 3 points only as against 8 the previous week. The margin of United Kingdom shares narrowed to 1s., leaving a net gain of 3d. The only changes in the Provinces occurred in Bristol, with a gain of 1 point to 113, and in Hartlepool consolidated which closed 2 lower at 88.

We are now in the season of final dividend announcements which are awaited with interest, and before next week's report is published a number of these will doubtless appear.

Official Quotations on the London Stock Exchange

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Jan. 13.	Rise or Fall on Week.
1,767,439	Sept. 5	8	8	Alliance & Dublin Ord. ...	130—140	...
374,000	Dec. 19	4	4	Do. 4 p.c. Deb. ...	93—98	...
734,733	Nov. 7	5	5	Asscd. Gas & Water U'd'ts Ord.	17/—19/–	...
500,000	,,	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	19/—21/–	...
444,389	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	19/—21/–	...
296,523	,,	4	4	Do. 4 p.c. Irred. Cum. Pref.	16/—18/–	...
500,000	Sept. 5	3½	3½	Do. 3½ p.c. Red. Deb. ...	93—98	...
560,070	Aug. 22	7	7	Barnet Ord. 7 p.c.	158—162	...
300,000	Oct. 10	1/9⅔	1/4⅔	Bombay, Ltd.	24/—26/–	...
180,435	Aug. 22	9½	9½	Bournemouth sliding scale ...	195—205	...
640,407	,,	7	7	Do. 7 p.c. max. ...	157—162	...
495,960	,,	6	6	Do. 6 p.c. Pref. ...	130—135	...
50,000	Dec. 19	3	3	Do. 3 p.c. Deb. ...	75—80	...
312,025	,,	4	4	Do. 4 p.c. Deb. ...	96—101	...
335,000	,,	5	5	Do. 5 p.c. Deb. ...	113—118	...
357,900	Aug. 8	7½	7½	Brighton, &c., 6 p.c. Con. ...	142—147	...
659,955	,,	6⅔	6⅔	Do. 5 p.c. Con. ...	126—131	...
205,500	,,	6	6	Do. 6 p.c. 'B' Pref.	127—132	+2
855,000	Sept. 19	8	7	British Ord.	132—137	−1
100,000	Dec. 19	7	7	Do. 7 p.c. Pref.	138—143	...
350,000	,,	5½	5½	Do. 5½ p.c. 'B' Cum. Pref.	112—117	...
120,000	,,	4	4	Do. 4 p.c. Red. Deb. ...	95—100	...
450,000	,,	5	5	Do. 5 p.c. Red. Deb. ...	100—105	...
450,000	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	90—95	...
100,000	22May'33	6	4	Cape Town, Ltd.	1—2	...
100,000	6 Nov.'33	4½	4½	Do. 4½ p.c. Pref. ...	1—2	...
150,000	Dec. 19	4½	4½	Do. 4½ p.c. Deb. ...	60—70	...
626,860	July 18	6	6	Cardiff Con. Ord.	118—123	...
237,860	Dec. 19	5	5	Do. 5 p.c. Red. Deb. ...	103—108	...
98,936	Sept. 19	2/–	2/–	Colombo Ord.	1⅛—1⅛	...
24,510	,,	1/4½	1/4½	Do. 7 p.c. Pref. ...	22/6—24/6	...
739,453	Oct. 10	–/11·48	–/11·48	Colonial Gas Assn. Ltd. Ord.	16/6—18/6	...
296,144	,,	1/3·30	1/3·30	Do. 8 p.c. Pref. ...	23/6—25/6	...
1,775,005	Aug. 8	5	5	Commercial Ord.	77—82	...
140,000	,,	—	§13/4	Do. 4 p.c. Red. Pref. ...	95—100	...
620,000	Dec. 5	3	3	Do. 3 p.c. Deb. ...	71—76	...
286,344	Aug. 22	5	5	Do. 5 p.c. Deb. ...	113—118	...
200,000	,,	—	§30/2	Do. 3½ p.c. Red. Deb. ...	97—102	...
807,560	Aug. 8	7	7	Croydon sliding scale ...	135—140	−1
644,590	,,	5	5	Do. max. div.	100—105	...
620,385	Dec. 19	5	5	Do. 5 p.c. Deb. ...	112—117	...
239,000	Aug. 8	5	5	East Hull Ord. 5 p.c.	95—100	...
186,155	Aug. 8	6	6	East Surrey Ord. 5 p.c. ...	116—121	...
176,211	Dec. 5	5	5	Do. 5 p.c. Deb ...	112—117	...
250,000	Nov. 7	8	4	Gas Consolidation Ord. 'B' ...	19/—21/–	...
250,000	,,	4	4	Do. 4 p.c. Red. Cum. Pref.	17/6—19/6	...
9,223,324	Aug. 8	5⅔	5⅔	Gas Light & Coke Ord. ...	22/—23/–a	—/3
2,600,000	,,	3½	3½	Do. 3½ p.c. max. ...	75—79	−1½
4,477,106	,,	4	4	Do. 4 p.c. Con. Pref. ...	97—100	−1
2,993,000	Jan. 9	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	96—99*	−2½
8,602,497	Nov. 21	3	3	Do. 3 p.c. Con. Deb. ...	75—78	−1
3,642,770	,,	5	5	Do. 5 p.c. Red. Deb. ...	109—113	...
3,500,000	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	107—111	...
700,000	Sept. 5	3½	3½	Do. 3½ p.c. Red. Deb. ...	93—98	...
270,466	Aug. 22	6	6	Harrogate New Cons. ...	117—122	...
157,500	Mar. 21	1/2⅜	‡1/–	Hong Kong and China Ord. ...	⅝—⅞	...
213,200	Aug. 8	6	5⅔	Hornsey Con. 3½ p.c.	97—102	...
5,600,000	Oct. 24	12	8	Imperial Continental Cap. ...	122—127	+3
223,130	July 18	3½	3½	Do. 3½ p.c. Red. Deb. ...	87—92	...
235,242	Aug. 8	8½	8½	Lea Bridge 5 p.c. Ord. ...	160—165	...
63,480	Dec. 19	3	3	Maidstone 3 p.c. Deb. ...	69—74	...
45,000	Nov. 21	†10	†10	Malta & Mediterranean ...	130—135	...
				Metropolitan (of Melbourne)		
392,000	Oct. 3	5½	5½	5½ p.c. Red. Deb.	100—105	...
231,977	Aug. 22	5	5	M.S. Utility 'C' Cons. ...	99—104	...
968,658	,,	4	4	Do. 4 p.c. Cons. Pref. ...	95—100	...

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Jan. 13.	Rise or Fall on Week.
390,076	Dec. 19	4	4	M.S. Utility 4 p.c. Deb. ...	95—100	...
148,955	,,	5	5	Do. 5 p.c. Deb. ...	112—117	...
125,000	Jan. 3	3½	3½	Do. 3½ p.c. Red. Bds.	94—97	...
675,000	Nov. 21	†6	†6	Montevideo, Ltd.	70—75	−2
250,000	Aug. 8	7½	7½	North Middlesex 6 p.c. Con.	142—147	...
396,160	Aug. 8	5	5	Northampton 5 p.c. max. ...	105—110	...
300,000	Oct. 24	†7	†9	Oriental, Ltd.	145—150	...
468,537	Dec. 5	8	7⅔	Plymouth & Stonehouse 5 p.c.	130—140	...
621,667	Aug. 8	8½	8½	Portsmouth & Gosport Cons.	157—162	...
241,446	,,	5	5	Do. 5 p.c. max. ...	100—105	...
73,350	,,	5	5	Do. 5 p.c. Pref. ...	107—112	...
75,000	,,	4	4	Do. 4 p.c. Pref. ...	90—95	...
114,000	Aug. 8	5	5	Preston 5 p.c. Pref.	105—110	...
247,966	Dec. 19	4	4	Primitiva 4 p.c. Cons. Deb. ...	96—101	...
625,959	Jan. 9	4	4	Do. 4 p.c. Red. Deb. ...	94—99*	...
15,000	Sept. 5	6	6	San Paulo 6 p.c. Cum. Pref. ...	8½—9	...
441,275	Sept. 19	1/1⅓	1/1⅓	Severn Val. Gas Cor. Ld. Ord.	20/6—22/6	...
460,810	Sept. 19	–/10⅔	–/10⅔	,, ,, 4½ p.c. Cum. Pref.	19/6—21/6	...
133,201	Aug. 22	5	8⅓	Shrewsbury 5 p.c. Ord. ...	143—148	...
9,000	June 3	4	‡4	South African Ord.	4½—5½	...
1,371,752	Aug. 22	1/2⅔	1/2⅔	South East'n Gas Cn. Ld. Ord.	21/—23/–	...
871,636	,,	–/10⅔	–/10⅔	Do. 4½ p.c. Red. Cum. Pref.	19/—21/–	...
498,818	,,	4	4	Do. 4 p.c. Cum. Pref. ...	18/—20/–	...
450,000	Aug. 8	4	4	Do. 4 p.c. Deb.	99—102	...
150,000	,,	3½	3½	Do. 3½ p.c. Red. Deb. ...	94—97	...
6,709,895	Aug. 8	6	5	South Met. Ord.	103—106	...
1,135,812	,,	6	6	Do. 6 p.c. Irred. Pref. ...	128—133	...
850,000	,,	4	4	Do. 4 p.c. Irred. Pref. ...	95—100	...
1,895,445	Dec. 19	3	3	Do. 3 p.c. Deb.	74—79	...
1,000,000	Jan. 9	5	5	Do. 5 p.c. Red. Deb. ...	108—111*	...
600,000	,,	§31/–	3⅓	Do. 3⅓ p.c. Red. Deb. ...	98—101*	...
1,543,795	Aug. 8	6	6	South Suburban Ord. 5 p.c. ...	113—118	...
512,825	,,	5	5	Do. 5 p.c. Pref.	108—113	...
500,000	,,	4	4	Do. 4 p.c. Pref.	95—100	...
250,000	,,	3¾	3¾	Do. 3¾ p.c. Red. Pref. ...	92—97	...
888,587	Dec. 5	5	5	Do. 5 p.c. Deb.	113—118	...
250,000	,,	4	4	Do. 4 p.c. Deb.	95—100	...
200,000	Aug. 8	3½	3½	Do. 3½ p.c. Red. Deb. ...	94—99	...
427,859	Sept. 19	8⅔	9⅓	S. Western Gas & Water Ord.	16/—18/–	...
160,523	Oct. 10	–/10⅔	–/10⅔	Do. 4½ p.c. Red. Cum. Pf.	19/—21/–	...
110,000	Dec. 19	4	4	Do. 4 p.c. Red. Deb. ...	93—98	...
750,541	Aug. 8	5½	5	Southampton Ord. 5 p.c. ...	105—110	...
148,836	Dec. 19	4	4	Do. 4 p.c. Deb.	93—98	...
350,000	Aug. 8	5½	5½	Swansea 5½ p.c. Red. Pref. ...	105—110	...
200,000	Dec. 19	3½	3½	Do. 3½ p.c. Red. Deb. ...	92—97	...
1,076,490	Aug. 8	6⅔	6⅔	Tottenham and District Ord.	125—130	...
409,835	,,	5⅓	5⅓	Do. 5⅓ p.c. Pref.	116—121	...
62,235	,,	5	5	Do. 5 p.c. Pref.	108—113	...
334,615	Dec. 5	4	4	Do. 4 p.c. Deb.	95—100	...
85,701	Jan. 9	6	6	Tuscan 6 p.c. Red. Deb. ...	95—100*	...
1,131,550	Aug. 22	6	4	U. Kingdom Gas Cor. Ord. ...	18/3—19/3	+–/3
1,051,280	Nov. 7	4½	4½	Do. 4½ p.c. 1st Cum. Pref.	19/—21/–	...
762,241	,,	4	4	Do. 4 p.c. 1st Red. Cum. Pf.	19/—21/–	...
745,263	Dec. 19	4½	4½	Do. 4½ p.c. 2ndNon-Cum.Pf.	15/6—17/6	...
1,066,186	Sept. 5	3⅓	3⅓	Do. 3⅓ p.c. Red. Deb. ...	96—99	+1
375,689	Aug. 8	7	7	Uxbridge, &c., 5 p.c.	125—130	...
133,010	,,	5	5	Do. 5 p.c. Pref. ...	108—113	...
1,371,138	Aug. 8	7	7	Wandsworth Consolidated ...	135—140	−1
2,525,768	,,	4	4	Do. 4 p.c. Pref.	95—100	...
1,343,964	Dec. 19	5	5	Do. 5 p.c. Deb. ...	113—118	...
383,745	,,	4	4	Do. 4 p.c. Deb. ...	95—100	...
400,000	,,	§25/–	3⅓	Do. 3⅓ p.c. Red. Deb. ...	96—101	...
558,342	Aug. 8	7	6⅔	Watford and St. Albans Ord.	128—133	...
200,000	,,	5	5	Do. 5 p.c. Pref. ...	107—112	...
200,000	,,	5⅓	5⅓	Do. 5⅓ p.c. Pref. ...	113—118	...
200,000	,,	—	16/8§	Do. 4 p.c. Red. Pref. ...	95—100	...
200,000	Dec. 19	4	4	Do. 4 p.c. Red. Deb. ...	95—100	...
200,000	,,	3⅓	3⅓	Do. 3⅓ p.c. Red. Deb. ...	92—97	...

a.—The quotation is per £1 of stock. * Ex. div. † Paid free of income-tax. ‡ For year. § Actual.

Supplementary List and Provincial Exchanges overleaf.

STOCK AND SHARE LIST—Cont.

Supplementary List, not Officially Quoted, London

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Nominal Quotations Jan. 13.	Rise or Fall on Week.
202,152	Sept. 5	5	5	Ascot Ord.	101—106	...
128,182	Dec. 19	5	5	Do. 5 p.c. Pref.	107—112	...
31,035	Aug. 22	–/4⅛	–/4⅛	Associated Utilities 4 p.c. Pref.	16/—18/–	...
100,000	Dec. 19	3½	3½	Do. 3½ p.c. Red. Deb. ...	95—100	...
17,000	Aug. 22	8	8	Bognor Orig. Ord. 'A' ...	155—165	...
62,210	,,	8	8	Do. New Addl. 'A' ...	155—165	...
87,160	,,	7	7	Do. New 7 p.c. max. ...	145—155	...
37,440	Aug. 8	10	10	Cam. Univ. & Town 10 p.c. max.	188—198	...
125,970	,,	7	7	Do. 7 p.c. max.	133—138	...
39,025	,,	5	5	Do. 5 p.c. max.	97—102	...
96,410	July 18	4½	4½	Cardiff 4½ p.c. Pref.	95—100	...
150,000	Aug. 8	4	4	Croydon 4 p.c. Pref.	97—100	...
130,000	Dec. 19	4	4	Do. 4 p.c. Deb.	95—100	...
65,000	Aug. 8	8½	7½	Eastbourne 'A' 5 p.c. ...	140—145	...
198,000	,,	7	6	Do. 'B' 3½ p.c.	114—119	...
112,312	,,	5	5	Do. 5 p.c. Pref.	107—112	...
130,000	Dec. 19	5	5	Do. 5 p.c. Deb.	110—115	...
24,000	Aug. 8	8½	8½	Great Yarmouth 8½ p.c. max.	43—48	...
59,400	,,	7⅛	7⅛	Do. 7⅛ p.c. max.	33—38	...
51,160	Dec. 5	5⅛	5⅛	Do. 5⅛ p.c. Deb.	120—125	...
152,600	Sept. 5	9	8	Guildford Cons.	163—168	...
54,055	,,	5	5	Do. 5 p.c. Pref.	107—112	...
68,250	Dec. 19	5	5	Do. 5 p.c. Deb.	110—115	...
156,600	Aug. 22	7¼	7¼	Hampton Court Cons. ...	126—131	...
80,000	Aug. 8	4	4	Lea Bridge 4 p.c. Pref. ...	90—95	...
60,000	,,	6	6	Do. 6 p.c. Pref.	121—126	...
94,876	Dec. 5	4	4	Do. 4 p.c. Deb.	94—99	...
73,620	Sept. 5	8⅛	8⅛	Luton Cons. 'A'	153—163	...
107,960	Sept. 19	5⅛	4	Mid Kent Ord.	8⅛—9⅛	...
230,940	Aug. 8	10	10	Oxford & District Ord. ...	195—200	...
47,112	,,	5	5	Do. 5 p.c. Pref.	106—111	...
50,000	,,	6	6	Do. 6 p.c. Red. Pref. ...	107—112	...
126,193	Nov. 7	7⅛	7⅛	Peterborough Ord.	137—142	...
64,990	Sept. 5	6⅛	7⅛	Redditch Ord....	118—128	...
166,850	Aug. 8	8	8	Romford Ord....	142—147	...
60,000	,,	4	4	Do. 4 p.c. Pref.	99—103	...
44,000	Sept. 19	5	5	Do. 5 p.c. Deb.	112—117	...
25,570	Aug. 8	5⅛	5⅛	Rugby 5⅛ p.c. Pref.	120—125	...
25,000	,,	6	6	Do. 6 p.c. Red. Pref. ...	104—109	...
42,750	Dec. 5	5⅛	5⅛	Do. 5⅛ p.c. Deb.	117—122	...
110,950	Aug. 22	8	8	Ryde Ord.	140—150	...
270,086	Sept. 5	7	7	Slough Ord.	128—133	...
21,000	Dec. 19	5	5	Do. 5 p.c. Deb.	108—113	...
28,872	Nov. 7	5⅛	5⅛	S. Midland Gas Cpn. Ltd. Ord.	17/—19/–	...
28,866	Sept. 5	4⅛	4⅛	Do. 4⅛ p.c. Red. Cum. Pref.	17/—19/–	...
117,228	Aug. 8	7	5	Swindon Cons.	102—107	...
60,425	Dec. 5	5	5	Do. 5 p.c. Deb.	110—115	...
64,380	Dec. 19	5	5	Torquay & Paignton 5 p.c. Pref.	105—110	...
130,000	Aug. 8	8	5	Wakefield Ord.	116—121	...
81,650	,,	5	5	Do. 5 p.c. max.	100—105	...
82,000	Aug. 8	6	6	Weymouth Ord.	103—108	...
98,384	Aug. 22	6	6	Wolverhampton 6 p.c. Pref.	118—123	...
160,000	Dec. 19	5⅛	5⅛	Do. 5⅛ p.c. Rd. Db.	103—108	...
90,000	Dec. 19	5	5	York 5 p.c. Red. Deb. ...	103—108	...
133,640	July 18	6⅛	6⅛	Yorktown (Cam.) 5 p.c. Cons.	118—123	...
120,000	,,	5	5	Do. 5 p.c. Pref.	105—110	...
35,000	Dec. 5	5⅛	5⅛	Do. 5⅛ p.c. Deb.	120—125	...

BRISTOL EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Jan. 13.	Rise or Fall on Week.
347,756	July 18	6	5	Bath Cons.	117—119	...
1,667,250	July 18	5	5	Bristol, 5 p.c. max.	112—114	+1
120,420	Dec. 19	4	4	Do. 1st 4 p.c. Deb. ...	98—101	...
217,870	,,	4	4	Do. 2nd 4 p.c. Deb. ...	98—101	...
328,790	,,	5	5	Do. 5 p.c. Deb.	117—120	...
274,000	Aug. 8	5	5	Newport (Mon.) 5 p.c. max. ...	97—99	...
13,200	Sept. 19	8⅞	7	Pontyp'l Gas & W. 10 p.c. 'A'	12⅞—13⅞	...
13,600	,,	6	5	Do. 7 p.c. 'B' ...	11¼—12¼	...
40,000	,,	6	5	Do. 7 p.c. 'C' ...	11¼—12¼	...
140,778	Aug. 8	5	5	Weston-super-Mare Cons. ...	106—108	...
64,338	Dec. 19	4	4	Do. 4 p.c. Deb. ...	98—101	...
33,340	,,	7⅛	7⅛	Do. 7⅛ p.c. Deb. ...	149—152	...

LIVERPOOL EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Jan. 13.	Rise or Fall on Week.
157,150	Aug. 8	6½	5	Chester 5 p.c. Ord.	109—111	...
92,500	Dec. 19	4	4	Do. 4 p.c. Pref.	95—99	...
36,430	,,	3½	3½	Do. 3½ p.c. Deb.	87—90	...
41,890	,,	4	4	Do. 4 p.c. Red. Deb. ...	97—101	...
2,167,410	Aug. 22	6	6	Liverpool 5 p.c. Ord.... ...	122—124	...
245,500	Dec. 19	5	5	Do. 5 p.c. Red. Pref. ...	100—105	...
306,083	July 18	4	4	Do. 4 p.c. Deb.... ...	100—102	...
106,280	Aug. 8	10	10	Preston 'A' 10 p.c.	198—208	...
188,219	,,	7	7	Do. 'B' 7 p.c.	131—141	...

NEWCASTLE EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Jan. 13.	Rise or Fall on Week.
122,577	Aug. 8	8	8	Blyth 5 p.c. Ord.	160—162	...
732,000	Aug. 22	5	5	Hartlepool G. & W. Cn. & New	87½—88½	–2
2,061,315	Aug. 8	5⅛	5	Newcastle & Gateshead Con.	22/9—23/3a	...
682,856	,,	4	4	Do. 4 p.c. Pref. ...	100—101	...
776,706	Dec. 19	3½	3½	Do. 3½ p.c. Deb. ...	87½—88½	...
277,285	Oct. 24	5	5	Do. 5 p.c. Deb. '43 ...	103½—105½	...
332,351	Aug. 22	6	6	Sunderland 6 p.c. max. ...	135—137	...

NOTTINGHAM EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Jan. 13.	Rise or Fall on Week.
542,270	Aug. 8	9	6	Derby Con.	133—138	...
55,000	Dec. 19	4	4	Do. 4 p.c. Deb.	100—105	...
20,000	Dec. 19	5	5	Long Eaton 5 p.c. Pref. ...	10—12	...
80,000	,,	5	5	Do. 5 p.c. Deb. ...	105—110	...

SHEFFIELD EXCHANGE

Issue. £	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Jan. 13.	Rise or Fall on Week.
10,000	Aug. 8	10	10	Great Grimsby 'A' Ord. ...	205—215	...
6,500	,,	10	10	Do. 'B' Ord. ...	205—215	...
79,000	,,	10	10	Do. 'C' Ord. ...	195—205	...
1,806,339	Aug. 22	6½	6½	Sheffield Cons.	139—141	...
95,000	Dec. 19	4	4	Do. 4 p.c. Deb.	100—102	...

a The quotation is per £1 of Stock.

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